United States Department of Agriculture

Soil Conservation Service

In cooperation with the Kentucky Agricultural Experiment Station, Kentucky Natural Resources and Environmental Protection Cabinet, and United States Department of Agriculture, Forest Service

Soil Survey of Bell and Harlan Counties, Kentucky

How To Use This Soil Survey

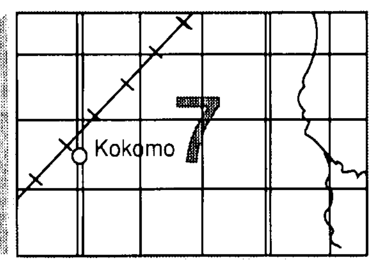
General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

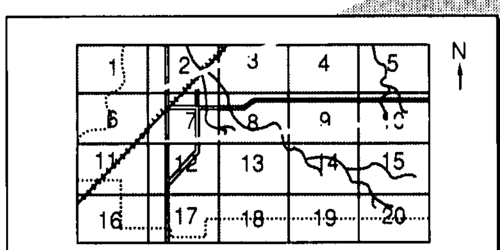
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.



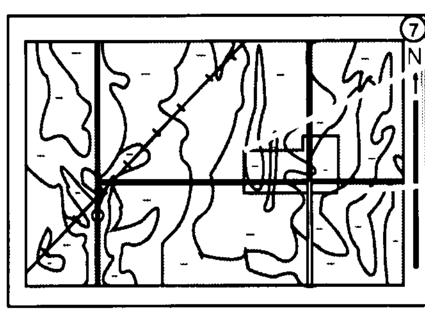
MAP SHEET

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



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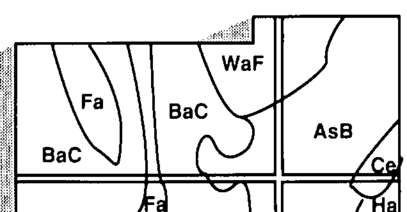

AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1988. Soil names and descriptions were approved in 1989. Statements in this publication generally refer to conditions in the survey area in 1987. The extent of the areas surface mined for coal, however, is based on aerial photographs taken in 1983. This soil survey was made cooperatively by the Soil Conservation Service, the Kentucky Agricultural Experiment Station, the Kentucky Natural Resources and Environmental Protection Cabinet, and the United States Department of Agriculture, Forest Service. It is part of the technical assistance furnished to the Bell County Conservation District and the Harlan County Conservation District. Both conservation districts provided financial assistance for the survey.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Early autumn colors in a forested area as viewed from Pine Mountain State Park.

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Foreword

This soil survey contains information that can be used in land-planning programs in Bell and Harlan Counties. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

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State Conservationist
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Soil Survey of
Bell and Harlan Counties, Kentucky

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United States Department of Agriculture, Soil Conservation Service and Forest Service, in cooperation with the Kentucky Agricultural Experiment Station and Kentucky Natural Resources and Environmental Protection Cabinet

BELL AND HARLAN COUNTIES are in the southeast corner of Kentucky (fig. 1). Bell County is 231,257 acres, or about 361 square miles, and Harlan County is 299,610 acres, or about 468 square miles. The two counties are bounded on the south by Tennessee, on the east by Virginia, and on the west and north by Whitley, Knox, Clay, Leslie, Perry, and Letcher Counties, Kentucky. Middlesboro, the largest urban area, is in the southern part of Bell County. Pineville is the county seat of Bell County, and Harlan is the county seat of Harlan County. In 1983, the population of Bell County was about 34,000 and that of Harlan County was about 42,000 *(51)*.

Urban areas and farms are along the more nearly level stream bottoms and the adjacent mountain foot slopes. The remaining areas in the counties mainly consist of wooded mountainous ridges and some areas that have been recently surface mined for coal. Coal mining is the major enterprise in the two counties.

This soil survey updates the survey of eastern Kentucky published in 1965 *(31)*. It provides updated series names and descriptions, larger maps that show the soils in greater detail, and additional information.

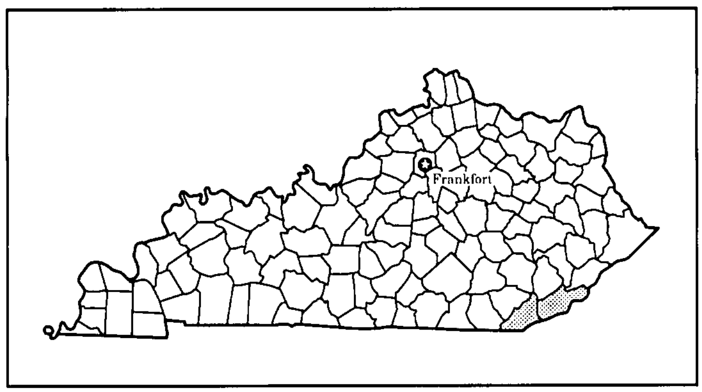

Figure 1.—Location of Bell and Harlan Counties, Kentucky.

General Nature of the Survey Area

This section gives general information about Bell and Harlan Counties. It describes history and settlement; physiography, relief, and drainage; soil, vegetation, and farming; mining and transportation facilities; and climate.

History and Settlement

Harlan County was established as the 60th county in the Commonwealth in 1819. It was named in honor of Silas Harlan, a Revolutionary War hero who fought at the battle of Blue Lick Springs in 1782. George Britain, a Lieutenant Colonel in the War of 1812 and a state representative, was instrumental in establishing the county.

Bell County was established in 1867. At that time it was known as Josh Bell County in honor of its founder. Josh Bell was the great-grandson of Dr. Thomas Walker and was a member of the Kentucky Legislature. In 1873, "Josh" was dropped from the county name.

Figure 2.—Historic Cumberland Gap. Many early settlers followed this route into Kentucky.

The first written record of exploration into the survey area dates to 1750, when Dr. Thomas Walker and his party of explorers came from Virginia en route to the Kentucky settlements. At that time Cumberland Gap and the part of the Cumberland River that cuts through Pine Mountain afforded the only direct passageway through the area. Both the gap and the river were named by Dr. Walker in honor of England's Duke of Cumberland.

In 1775, Daniel Boone and his exploration party traveled through the area to make a packhorse trail to Boonesboro, Kentucky. This trail is commonly referred to as the "Wilderness Road." It entered Bell County at Cumberland Gap, passing almost straight up the mountain into the gap (fig. 2). Parts of U.S. Highway 25E, which runs between Middlesboro and Pineville, follow the course of the Wilderness Road.

A popular area of settlement for early pioneers was located near the gap in Pine Mountain commonly referred to as the "Narrows." At this point, people traveling through Cumberland Gap northward in search of more nearly level farmland could cross the Cumberland River. In 1781, pioneers who decided to stay and settle in this area named it Cumberland Ford. Prior to the establishment of Bell County, the name was changed to Pineville. The first tollgate in Kentucky was established in 1795 at the "Narrows" to raise money for improvements on the Wilderness Road *(20)*.

Early scouts blazed a trail from the western part of Virginia into the area now known as Harlan County.

They probably came through Cranks Gap down to the mouth of Poor Ford, or Poor Fork, to the community that is now Baxter *(12)*. Early families had to carry their possessions most of the way because the narrow passageways were not wide enough to allow for a team of oxen.

Most of the early pioneers in Harlan County were English, Scotch, Irish, German, or French. Many had fought in the Revolutionary War and received military land grants. Therefore, early settlements in the county were controlled to some degree by the provisions of the grants. Early communities were located along Martins Fork, Clover Fork, and Poor Fork and at Mount Pleasant (later named Harlan). About 10 or 12 families made up the majority of the population when Harlan County was established in 1819.

The earliest settlers in both counties relied on subsistence farming for their survival. Field crops consisted chiefly of corn, cane, hemp, oats, flax, and tobacco. Most farms were on the more nearly level, fertile flood plains.

By 1890, the lumber business had become the main industry. An abundance of virgin yellow poplar, American chestnut, walnut, and oak in the mountains supported a thriving enterprise. Three big lumber companies competed for the quality hardwoods. The biggest market for timber was the Asher Mill at Wasioto, in Bell County. In 1895, this sawmill was capable of handling over 50,000 board feet of lumber daily through double saw bands.

Railroads played a key role in the development and prosperity of the survey area. Prior to the late 1800's, the Louisville and Nashville (L&N) Railroad extended only as far as Corbin. In 1888, it connected Pineville to Corbin. In 1889, it reached Cumberland Gap. The development of the railroad in Harlan County was largely the result of the efforts of a local businessman, T.J. Asher. The line to Harlan opened in about 1911. L&N secured the rights to this line and continues to maintain it *(22)*.

After the railways were built, the coal industry began to grow. Some of the richest veins of coal in the country were discovered in the mountains of the survey area. In practically all of the mines in Bell and Harlan Counties, nearly horizontal passageways were opened into the mountains at the level of the seams. By 1910, the coal industry had replaced the lumber industry as the major commercial enterprise.

The thirties and forties were prosperous years for the mining industry in Bell and Harlan Counties. Major companies invested heavily in coal and mineral rights in the two counties. In the mid to late thirties, annual coal production exceeded 14 million tons in Harlan County and 2.5 million tons in Bell County. The population grew until the late forties, when economic changes in the coal business resulted in the first outmigration of people. Though cyclical in nature, the mining industry still plays a major role in the economy of the two counties and continues to serve as the greatest source of personal income.

Physiography, Relief, and Drainage

Bell and Harlan Counties are part of the Cumberland Plateau and Mountains *(3)*. The Cumberland Plateau is a dissected area of varying altitude and relief. Two prominent linear ridges, Pine Mountain and Cumberland Mountain, extend across the area. These ridges are underlain by tilted sandstone, shale, and limestone of the Lower Pennsylvanian and Mississippian Systems. In other areas the mountains are underlain by siltstone, shale, sandstone, and coal of the Pennsylvanian System.

Generally, the landscape in the survey area is mountainous and consists of sharp-crested ridges and deep, V-shaped valleys. The slopes on the valley sides generally are 35 to 75 percent. Small areas of more nearly level slopes are along the narrow stream bottoms. In a few places the mountaintops are rounded and have slopes of 5 to 20 percent. The elevations along the stream bottoms range from about 1,000 to 1,600 feet. The mountaintops are 600 to 2,200 feet above the stream bottoms. The highest point in Kentucky, 4,145 feet, is on Black Mountain, in Harlan County *(32)*.

Most of the survey area is in the upper basin of the Cumberland River. Small areas are along the upper reaches of the Kentucky River. Pine and Cumberland Mountains have influenced the course of many streams in the area. Elsewhere, the drainage pattern generally is dendritic, like the branching pattern of a tree, and the flow of most streams is to the north and west. Pine and Cumberland Mountains are watershed divides and are crossed by only one stream within the survey area. The Cumberland River flows through the deep gap in Pine Mountain at Pineville. The area north of the Kentucky Ridge is drained by the Red Bird River, a tributary of the South Fork of the Kentucky River. Several small tributaries of the Middle Fork of the Kentucky River drain an area north of Pine Mountain in Harlan County. The chief water impoundments are Cranks Creek Lake and Martins Fork Lake in Harlan County and Cannon Creek Lake and Fern Lake in Bell County.

Soil, Vegetation, and Farming

Bell and Harlan Counties have about 24 major kinds of soil. The soils range widely in texture, natural drainage, and other characteristics. Most of the steep mountainsides are mantled by deep and very deep, loamy soils, which contain varying amounts of rock fragments. The soils on the stream bottoms are loamy. The only gravelly soils are those along the upper reaches of the streams. Generally, the topsoil is dark and ranges from a few inches to 20 inches or more in thickness. The subsoil commonly is pale colored and acid. In a few places on the stream bottoms, the soils are wet and gray.

Second-growth deciduous forest, consisting mainly of maple, beech, yellow poplar, oak, and hickory, covers about 85 percent of the survey area. On the cool slopes in the mountains, these species are mixed with buckeye and basswood. In areas where the soil is shallow or droughty, oak or oak mixed with pine is common. Some hemlock grows in the deep ravines.

Most areas along the stream bottoms have been cleared and are used for pasture, hay, or corn. Most farms are small and include steep, wooded slopes. Farming has declined in importance in the last 50 years. Many areas once cleared and pastured or used for corn are now considered too steep for farming. Along the stream bottoms, much of the farmland has been converted to urban uses.

Mining and Transportation Facilities

Coal has been commercially mined in the survey area since the late 19th century. Numerous bituminous coal seams ranging from a few inches to several feet in thickness occur in the sedimentary rocks of the Pennsylvanian System. Most coal seams currently being mined are about 2 to 5 feet thick. Both surface mines and underground mines with drift entrances are used. In 1985, about 6 million tons was mined in Bell County and about 13 million tons was mined in Harlan County. Surface mining accounted for about 60 percent of the total tonnage in Bell County and 10 percent of the tonnage in Harlan County *(30)*.

Oil and gas deposits are discovered mainly in the pre-Pennsylvanian rocks north of Pine Mountain. Several small oil and gas fields are producing in this area.

Limestone on the north slope of Pine Mountain is quarried for road-construction material and concrete aggregate. Sandstone quarried on the south slope of Pine Mountain is used for quartz sand, gravel, and building stone.

Most areas where coal is being actively mined are served by railroads. Highways, roads, and railroads generally are parallel to streams. The major highways in the survey area are U.S. Highways 25E, 119, and 421. Airports serving light aircraft are located near Harlan and in Middlesboro.

Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Baxter, Kentucky, in the period 1951 to 1987. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 35 degrees F and the average daily minimum temperature is 24 degrees. The lowest temperature on record, which occurred at Baxter on January 21, 1985, is -19 degrees. In summer, the average temperature is 73 degrees and the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred at Baxter on August 22, 1983, is 101 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 50 inches. Of this, 25 inches, or 50 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 22 inches. The heaviest 1-day rainfall during the period of record was 5.03 inches at Baxter on October 2, 1977. Thunderstorms occur on about 46 days each year.

The average seasonal snowfall is 14.5 inches. The greatest snow depth at any one time during the period of record was 9 inches. On an average of 8 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 45 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in spring.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material from which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area are generally collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

The soil lines on the general soil maps of Bell and Harlan Counties match those on the maps of the adjoining counties; however, the soil names do not correspond. Differences are the result of the relative proportions of the soils in the counties and refinements in the classification of the soils.

Most soil lines on the detailed soil maps of Bell and Harlan Counties match those on the maps of adjoining counties; a few do not join. Differences result from surface mining activities that affect the kinds of soil mapped, refinements or modifications in the design of map units, and improvements in the photographic base used to plot the soil lines. In most places the soil names do not fully agree. These differences are generally the result of laboratory analysis that improved the classification of the soils.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. In the detailed soil map units, these latter soils are called inclusions or included soils. In the general soil map units, they are called soils of minor extent.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

Survey Procedures

The general procedures followed in making this survey are described in the "National Soils Handbook" of the Soil Conservation Service and in the "Soil Survey Manual" *(46)*. The "Reconnaissance Soil Survey of Fourteen Counties in Eastern Kentucky" *(31)* and other surveys of areas in the Cumberland Plateau and Mountains *(3)* were used as references.

Before fieldwork began, preliminary boundaries of slopes and landforms were plotted stereoscopically on quad-centered aerial photographs taken in 1983 and 1984 at a scale of 1:80,000 and enlarged to a scale of 1:24,000. United States Geological Survey geologic and topographic maps at a scale of 1:24,000 were also used *(52 to 75)*. Map units were then designed according to the pattern of soils interpreted from photographs, maps, and field observations *(48)*.

Two levels of mapping intensity were used in this survey. More closely spaced observations were made in the valleys where the soils are used for agriculture or urban development. Less closely spaced observations were made in the mountainous areas where the soils are used as woodland and wildlife habitat or are being mined for coal. For either level of mapping intensity, the information about the soils can be used to determine soil management and to predict the suitability of the soils for various uses.

Traverses in the valleys were made by truck or on foot. The soils were examined at intervals ranging from a few hundred feet to about ¼ mile, depending on the landscape and soil pattern. Observations of special features, such as landforms, vegetation, and evidence of flooding, were made continuously without regard to spacing. Soil boundaries were determined on the basis of soil examinations, observations, and photo interpretations. In many areas, such as those where very steep slopes intersect with flood plains, these boundaries are precise because of an abrupt change in the landform. The soils were examined with the aid of a hand probe, a bucket auger, or a spade to a depth of about 3 to 5 feet. The typical pedons were observed in pits dug by hand. Additional soil descriptions were obtained through statistical sampling techniques.

Traverses in the mountainous areas were made by truck or on foot along the existing network of roads and trails. These traverses commonly were made a few miles apart where the geologic materials and landscapes were uniform. In areas where differences in geologic material or landscape were observed, traverses were made at intervals close enough for the soil scientists to observe any differences among the soils. Examinations were made at intervals ranging from a few hundred feet to about ¼ mile. Observations of landforms and vegetation were made continuously without regard to spacing. Where soil profiles were readily observable, such as along recently constructed mining access roads, along highwalls, and along logging roads, observations of the content of rock fragments, depth to bedrock, depth of rooting, the landform, and the underlying material were made without regard to spacing. Soil boundaries were plotted stereoscopically on the basis of parent material, landform, and relief. Many of these boundaries cannot be exact because they fall within a zone of gradual change between landforms, such as an area where a mountain crest becomes a mountainside. Much intermingling of the soils occurs in these zones. Soil descriptions were obtained through statistical sampling techniques.

Samples for chemical and physical analyses were taken from the site of the typical pedon of the major soils in the survey area. Most of the analyses were made by the Soil Survey Investigations Staff, Lincoln, Nebraska. Some soils were analyzed by the Kentucky Agricultural Experiment Station. Commonly used laboratory procedures were followed *(50)*.

The results of the analyses of selected soils are given in tables 18 and 19. In addition to the selected data published in this survey, similar data were collected on Alticrest, Cloverlick, Craigsville, Cutshin, Gilpin, Guyandotte, Helechawa, Highsplint, Kimper, Philo, Pope, Shelbiana, Shelocta, Totz, and Varilla soils. For some of these soils, only a few horizons were analyzed.

After completion of the soil mapping on quad-centered aerial photographs, map unit delineations were transferred by hand to orthophotographs at a scale of 1:24,000. Surface drainage and cultural features were transferred from 7.5-minute topographic maps of the United States Geological Survey.

Statistical Sampling and Analysis

Statistical sampling techniques were used to obtain data on the components, or kinds of soil, that make up the map units. The number of sampling stages and the methods used varied, depending on the ease in obtaining data and on the kind of data to be obtained *(44)*.

Prior to the statistical sampling of map units, a study was made on the short-distance variability of the soils in order to optimize the transects *(77)*. A transect on a warm slope and one on a cool slope were made. They included 50 points at intervals of 50 feet.

Initially, about four delineations of each map unit were randomly sampled *(45)*. Each delineation was stratified where possible. Within each stratum points were selected using random point-intercept transects or random observations. In the mountainous areas, strata representing the upper, middle, and lower third of the mountain were used. In other areas differences in landform, vegetation, or distance to stream channels were used in determining strata.

Four points located 200 feet apart were used in each stratum in the mountainous areas. These points were along a line roughly at a 45-degree angle to the pattern of the ephemeral streams on the mountainside *(6)*. Generally, two points located 100 or 200 feet apart were used within each stratum along flood plains and in areas that have been disturbed by surface mining. At each point, soil profiles were described and classified using field procedures and tabulated as a named component, a similar soil, or a contrasting inclusion.

Similar soils are soils that are within the normal error of observation *(49)*. Normal errors of observation for several soil properties in the survey area are as follows: percent clay—3 to 5; percent sand—10 to 15; percent rock fragments—5 to 10; colors—one unit of hue, value, or chroma; pH—0.5 to 0.75; and percent base saturation—25. Where compared to data from pedons sampled during fieldwork, field estimates were within these errors of observation four out of five times. In some map units the normal error range for similar soils was broadened to facilitate naming if use and management requirements were not affected.

Data from the initial sample were used to determine the number of observations required for each map unit. Stein's two-stage sample test was used with a desired interval of 10 percent about the mean and a confidence level of 0.90 *(44)*. Where an additional number of observations were indicated by this test, either additional delineations were sampled or the desired interval was increased to 15 percent about the mean, or both.

The average composition of the delineations for each map unit was calculated along with simple statistics based on an approximation of the binomial distribution *(5)*. The results are given in table 4.

General Soil Map Units

The general soil map at the back of this survey shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or a building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Steep and Very Steep, Well Drained Soils That Have a Loamy Subsoil; on Mountains

These are very deep to moderately deep soils that have a loamy surface layer and subsoil and have varying amounts of rock fragments throughout. The soils formed in material weathered from siltstone, shale, and fine grained sandstone. The underlying bedrock is of Pennsylvanian age and has numerous coalbeds a few inches to about 5 feet thick.

These soils make up about 76 percent of Bell County and 83 percent of Harlan County. The kinds of soil, elevation, and relief vary.

Mixed hardwoods grow on most of the soils in the mountains. Scattered areas that have been surface mined for coal are throughout the units. Most of the soils in narrow valleys have been cleared and are used for pasture, row crops, or urban development. The slope in the uplands and flooding in the narrow valleys are the main limitations affecting most uses.

1. Shelocta-Gilpin-Kimper

Very deep to moderately deep soils that have a loamy subsoil; in mountainous areas with relief of 600 to 1,200 feet

This map unit consists of soils on dissected mountains (fig. 3). About half of the unit is north and west of Pine Mountain. Elevations along the mountain crests generally are 2,000 to 2,250 feet but range from about 1,600 to 2,500 feet. In most areas slopes range from 20 to 75 percent.

This map unit makes up about 63 percent of Bell County and 29 percent of Harlan County. It is about 45 percent Shelocta and similar soils, 20 percent Gilpin and similar soils, 19 percent Kimper and similar soils, and 16 percent soils of minor extent.

The steep and very steep, deep and very deep, well drained Shelocta soils are on hills and mountains. Typically, the surface layer is dark brown gravelly loam. The subsoil is yellowish brown gravelly silt loam in the upper part, strong brown loam in the next part, and strong brown channery loam in the lower part.

The steep and very steep, moderately deep, well drained Gilpin soils are on hills and mountains. Typically, the surface layer is loam. It is very dark grayish brown in the upper part and yellowish brown in the lower part. The subsoil is yellowish brown channery loam. Beneath this is siltstone bedrock.

The very steep, deep and very deep, well drained Kimper soils are on mountainsides. Typically, the surface layer is dark brown silt loam. The subsurface layer is brown silt loam. The subsoil is yellowish brown channery loam.

Of minor extent are the gently sloping to very steep Fairpoint and Bethesda soils in surface-mined areas; the nearly level to moderately steep Highsplint soils on foot slopes; and the nearly level Bonnie, Philo, Pope, and Craigsville soils on flood plains.

Most areas of this map unit are used as woodland. A few areas along narrow flood plains and on some of the mountain summits have been cleared and are used for farming.

These soils are generally unsuitable for farming because of the slope and surface stoniness. The nearly level minor soils on flood plains and the gently sloping to moderately steep minor soils on foot slopes are cultivated or pastured. They are suitable for cultivated crops and pasture. These minor soils make up 6 percent or less of the map unit.

The major soils are suited to woodland and to woodland wildlife habitat. Woodland productivity is

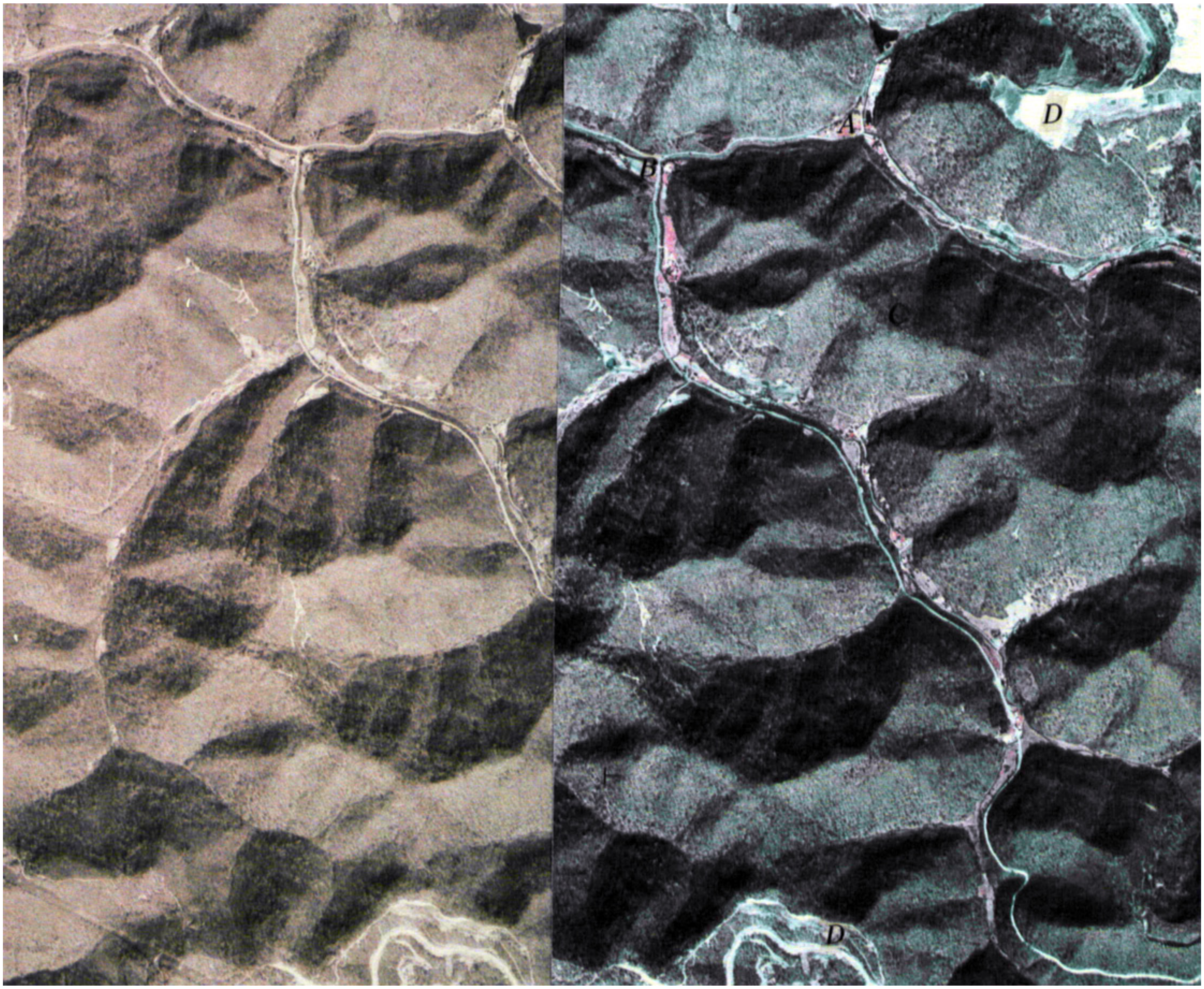

Figure 3.—Typical topography of the Shelocta-Gilpin-Kimper general soil map unit near Beverly (A), in Bell County. The confluence of Lawson Creek and the Red Bird River is to the left of Beverly (B). The crest of the mountain ridge (C) is about 600 feet in elevation above the flood plain. Areas surface mined for coal are light colored (D). The scale is about 1:24,000. Photograph provided by the United States Department of the Interior, Geological Survey. Use a stereoscope for a three-dimensional view.

moderate on the ridgetops and on the warm slopes. It is high on the cool slopes. The most common tree species are American beech, white oak, chestnut oak, sugar maple, and yellow poplar. The main management concerns are the hazard of erosion, the equipment limitation, and plant competition.

In most areas these soils are unsuited to urban development because of the slope.

2. Highsplint-Cloverlick-Guyandotte

Deep and very deep soils that have a gravelly or channery, loamy subsoil; in mountainous areas with relief of 1,200 to 2,200 feet

This map unit consists of soils in highly dissected areas on Black Mountain, Little Black Mountain, and part of Log Mountain (fig. 4). Elevations along the mountain crests commonly range from 2,800 to about 4,000 feet. In most areas slopes range from 20 to 75 percent.

This map unit makes up about 13 percent of Bell County and 54 percent of Harlan County. It is about 38 percent Highsplint and similar soils, 34 percent Cloverlick and similar soils, 18 percent Guyandotte and similar soils, and 10 percent soils of minor extent.

The steep and very steep, deep and very deep, well drained Highsplint soils are on mountains. Typically, the surface layer is dark brown very channery silt loam. The subsoil is yellowish brown. It is very channery silt loam in the upper part, very channery silty clay loam in the next part, and very channery loam in the lower part.

The steep and very steep, deep and very deep, well drained Cloverlick soils are on mountains. Typically, the surface layer is very dark gray gravelly loam. The upper part of the subsoil is brown and yellowish brown gravelly loam, the next part is yellowish brown very gravelly and extremely gravelly loam, and the lower part is yellowish brown extremely flaggy loam.

The steep and very steep, very deep, well drained

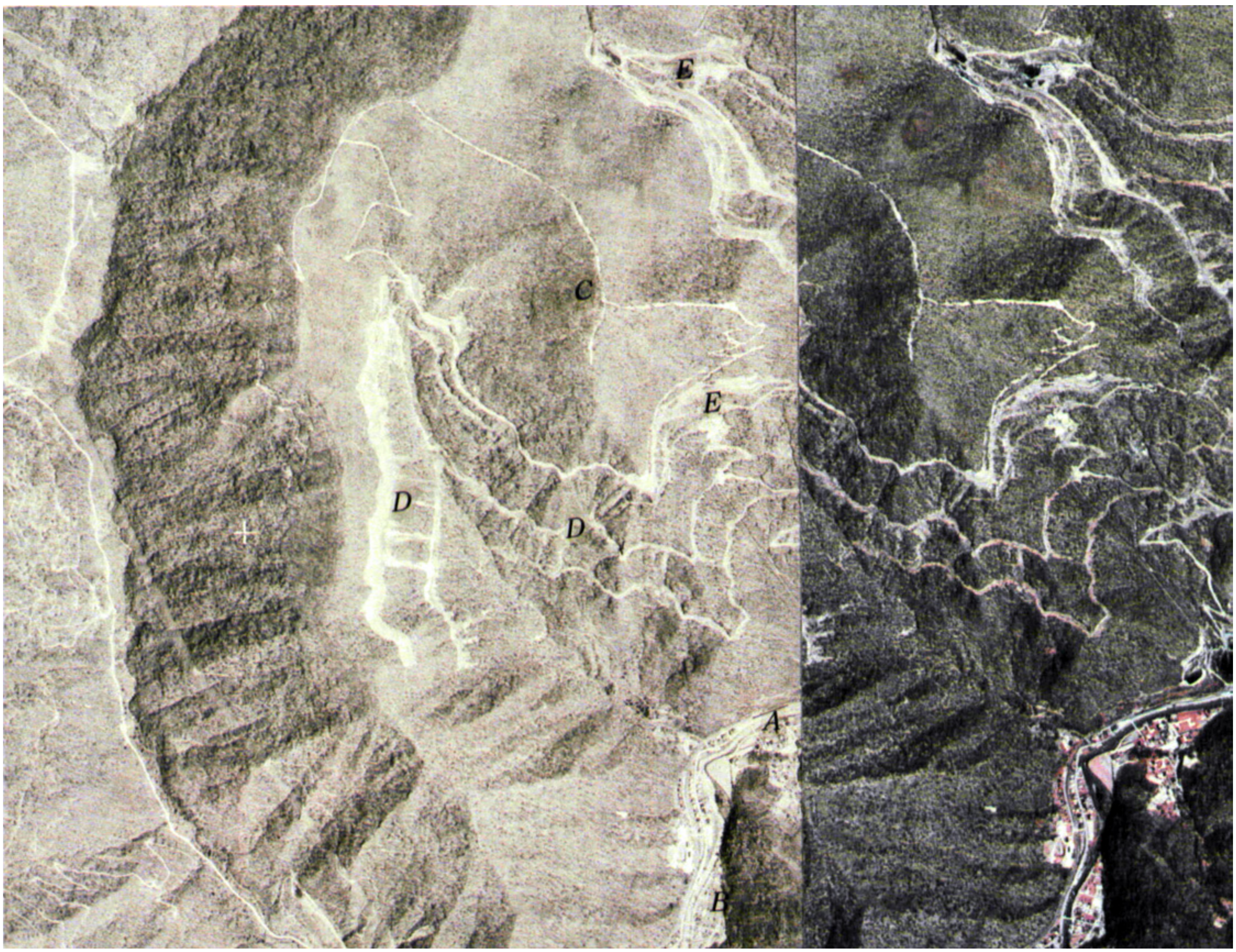

Figure 4.—Typical topography of the Highsplint-Cloverlick-Guyandotte general soil map unit near Closplint (A), in Harlan County. Kentucky Highway 38 and a railroad are on the flood plain (B) along the Clover Fork of the Cumberland River. The crest of a spur is about 2,050 feet in elevation above the flood plain (C). Areas surface mined for coal appear light colored (D). Much of the coal in this area is removed from underground mines (E). The scale is about 1:24,000. Photograph provided by the United States Department of the Interior, Geological Survey. Use a stereoscope for a three-dimensional view.

Guyandotte soils are on mountains. Typically, they are very channery loam in the surface layer and subsoil. The surface layer is very dark grayish brown in the upper part and dark brown in the lower part. The subsoil is dark yellowish brown in the upper part and yellowish brown in the lower part.

Of minor extent are the gently sloping to very steep Fairpoint and Bethesda soils in surface-mined areas; the gently sloping to moderately steep Gilpin, Shelocta, and Kimper soils on alluvial fans, foot slopes, and mountain summits; and the nearly level Craigsville, Philo, and Pope soils on flood plains.

Most areas of this map unit are used as woodland. A few areas along narrow flood plains have been cleared and are used for farming.

These soils are generally unsuitable for farming because of the slope and surface stoniness. The nearly level minor soils on flood plains and the gently sloping to moderately steep minor soils on foot slopes and some mountain summits are cultivated or pastured. They are suitable for cultivated crops and pasture. These minor soils make up 4 percent or less of the map unit.

The major soils are suited to woodland and to woodland wildlife habitat. Woodland productivity is moderate on ridgetops and on the warm slopes. It is high on the cool slopes. The most common tree species are sugar maple, yellow poplar, chestnut oak, black locust, red maple, and American basswood. The main management concerns are the hazard of erosion, the equipment limitation, and plant competition.

In most areas these soils are unsuited to urban development because of the slope.

Steep and Very Steep, Well Drained and Somewhat Excessively Drained Soils That Have a Loamy Subsoil; on Mountains

These are very deep to moderately deep soils that have a loamy surface layer and subsoil and have varying amounts of rock fragments throughout. The soils formed in material weathered from sandstone and siltstone and, in places, from limestone or shale. The underlying bedrock is of Pennsylvanian, Mississipian, or Devonian age. It has a few beds of coal, which are as much as 2 feet thick.

These soils make up about 18 percent of Bell County and 17 percent of Harlan County. The kinds of soil vary because of the effects of the underlying bedrock.

Mixed hardwoods and pine grow on most of the soils in the mountains. A few small areas near the base of the mountains have been cleared and are used as pasture. The slope and rock outcrops or cliffs are the main limitations affecting most uses.

3. Helechawa-Alticrest-Varilla

Steep and very steep, very deep to moderately deep, somewhat excessively drained soils; on mountains

Most of this map unit consists of soils on the south- and east-facing side of Pine Mountain and the north- and west-facing side of Cumberland Mountain and Brush Mountain (fig. 5). The slopes to the base of the mountains are broken by the edges of many strata, which are mainly sandstone and siltstone. Some areas of the map unit are on Rocky Face Mountain, White Mountain, and some low mountains in the vicinity of Kettle Island. Cliffs, "hogbacks," and "rockhouses" are common. The main ravines are about one-half mile apart along the mountainsides. Elevations generally range from 1,000 to 1,600 feet along the base of the mountains to about 2,000 to 2,800 feet near the summits. They are 2,800 to 3,500 feet, however, in a few areas. In most areas slopes range from 20 to 75 percent.

This map unit makes up about 14 percent of Bell County and 15 percent of Harlan County. It is about 39 percent Helechawa and similar soils, 33 percent Alticrest and similar soils, 23 percent Varilla and similar soils, and 5 percent soils of minor extent.

The steep and very steep, deep and very deep Helechawa soils are on mountains. Typically, the surface layer is very dark grayish brown sandy loam. The subsoil is yellowish brown sandy loam. The substratum is strong brown loamy sand.

The steep, moderately deep Alticrest soils are on mountains. Typically, the surface layer is very dark grayish brown fine sandy loam. The subsoil is yellowish brown. It is fine sandy loam in the upper part, loam in the next part, and gravelly fine sandy loam in the lower part. Beneath this is sandstone bedrock.

The steep and very steep, deep and very deep Varilla soils are on mountains. Typically, the surface layer is very dark grayish brown gravelly fine sandy loam. The subsoil is yellowish brown. It is gravelly fine sandy loam in the upper part, very cobbly fine sandy loam in the next part, and extremely cobbly loamy sand in the lower part.

Of minor extent are the gently sloping to moderately steep Crossville, Jefferson, Gilpin, and Shelocta soils on foot slopes, mountain summits, and alluvial fans and the nearly level Pope soils on flood plains.

Most areas of this map unit are used as woodland. A few areas along narrow flood plains and on the mountain summits have been cleared and are used for farming. The small, intermingled areas of rock outcrop support no vegetation or have a sparse cover of shrubs and dwarf trees. In a few places the sandstone has

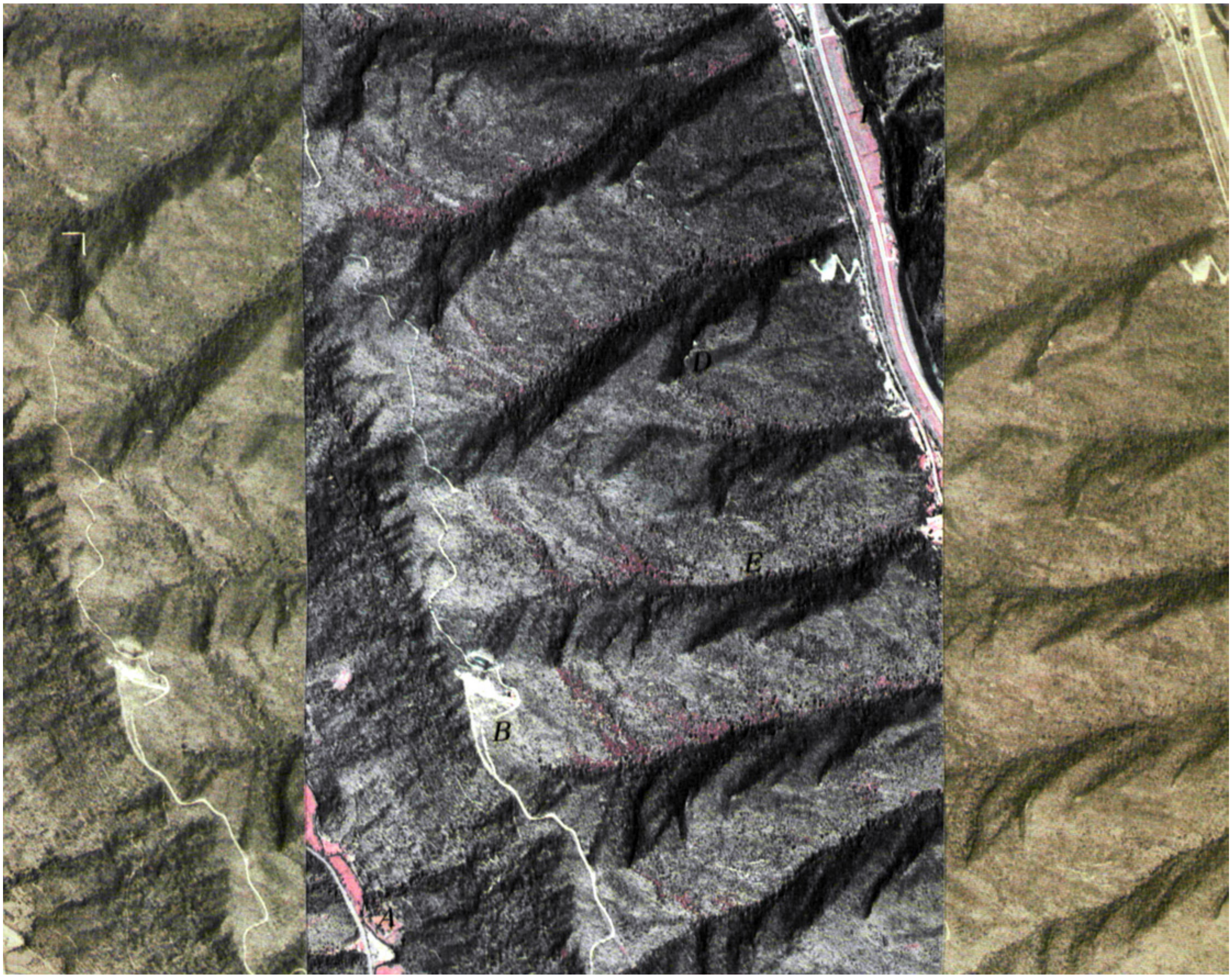

Figure 5.—Typical topography of the Helechawa-Alticrest-Varilla general soil map unit in an area of Pine Mountain northeast of Rosspoint, in Harlan County. Laurel Fork (A) is in the lower part of the photograph. Little Shepherd Trail (B) is near the crest of the mountain. Cliffs (C) and hogbacks (D) are common on the south-facing side of the mountain. Areas of dark vegetation (E) are mostly hemlock in the ravines and oak and pine on the ridges. The Poor Fork of the Cumberland River, U.S. Highway 119, and a railroad (F) are on the narrow flood plain in the upper part of the photograph. The scale is about 1:24,000. Photograph provided by the United States Department of the Interior, Geological Survey. Use a stereoscope for a three-dimensional view.

been quarried for sand, gravel, or building stone.

These soils are generally unsuitable for farming because of the slope and surface stoniness. The nearly level minor soils on flood plains and the gently sloping to moderately steep minor soils on foot slopes and some mountain summits are cultivated or pastured. They are suitable for cultivated crops and pasture. These minor soils make up 2 percent or less of the map unit.

The major soils are suited to woodland and to woodland wildlife habitat. Woodland productivity is moderate on low ridges and moderate or high in the ravines. The most common tree species are Virginia pine, pitch pine, scarlet oak, chestnut oak, and hickory on the ridges and eastern hemlock, American beech, white oak, chestnut oak, sugar maple, and yellow poplar in the ravines. The main management concerns are the hazard of erosion, the equipment limitation, and plant competition.

In most areas these soils are unsuited to urban

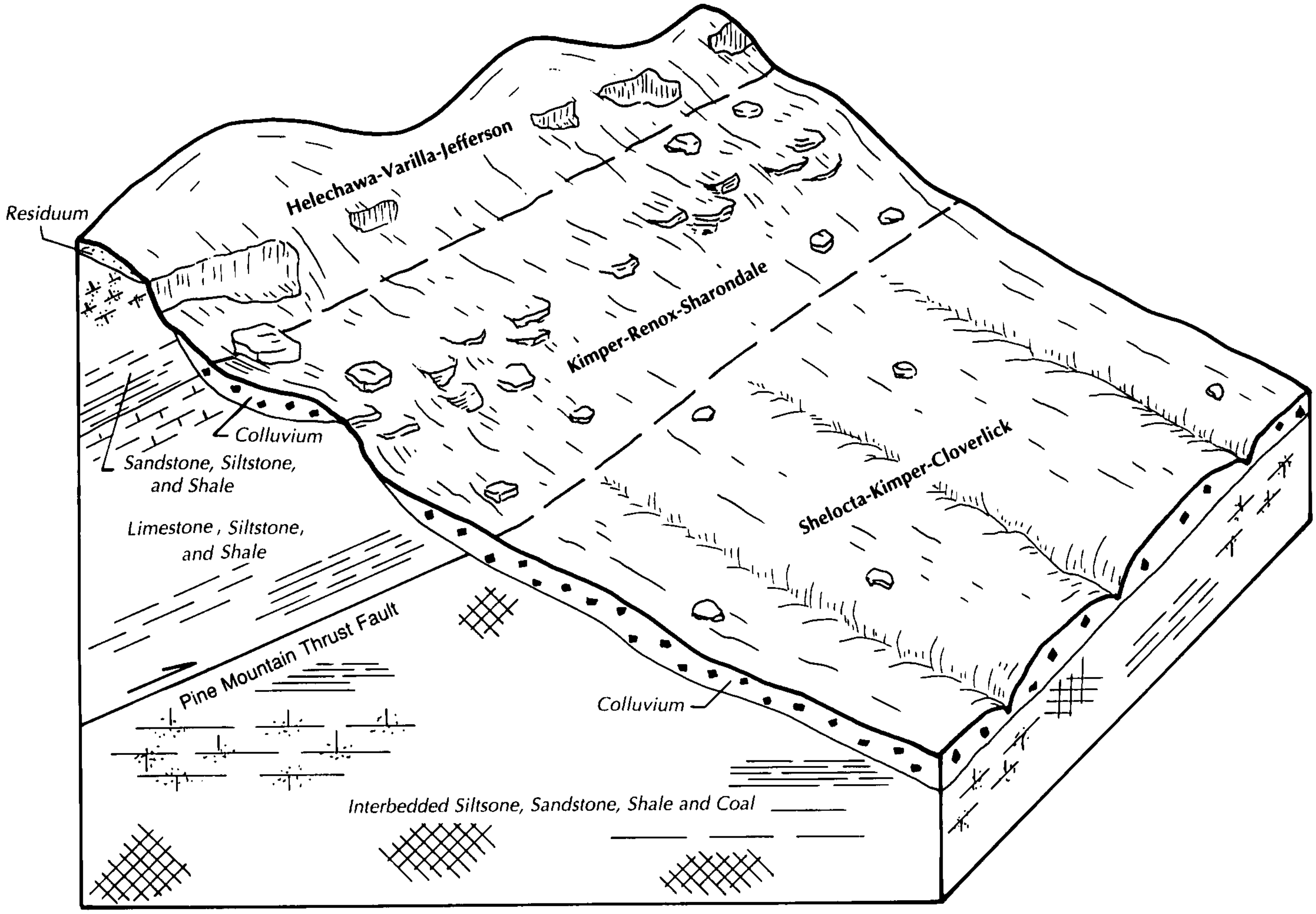

Figure 6.—Typical pattern of soils in the Kimper-Shelocta-Varilla general soil map unit, showing the relationship of the soils to parent material and topography.

development because of the slope. They are suitable as extensive recreation areas. The most common recreational activities are hunting, fishing, camping, and hiking. Recreational use of off-road vehicles also is common. Tracts of land that are open to the public include Cumberland Gap National Historical Park, Pine Mountain State Park, Kentenia and Kentucky Ridge State Forests, and the Cranks Creek Wildlife Management Area.

4. Kimper-Shelocta-Varilla

Very steep, deep and very deep, well drained and somewhat excessively drained soils; on mountains

This map unit consists of soils on the north- and west-facing sides of Pine Mountain, a prominent ridge formed through faulting. The north and west sides, which are referred to as the scarp slopes, are the eroded edges of upturned rock strata. These strata are sandstone, siltstone, and shale on the uppermost cliffs; limestone, siltstone, and shale on benches and midslopes; and a sequence of siltstone, sandstone, shale, and coal on the lower slopes (fig. 6). The soils formed in colluvial material derived from these rocks. Elevations range from 1,000 feet along the base of the mountain to about 2,500 feet along the summit. Streams are very small and run from the summit to the base. The base has slightly irregular slopes because of cones of colluvial and alluvial material. Cliffs and rock outcrops are common at the higher elevations. Slopes range from 35 to 75 percent.

This map unit makes up about 4 percent of Bell County and 2 percent of Harlan County. It is about 51 percent Kimper and similar soils, 28 percent Shelocta and similar soils, 17 percent Varilla and similar soils, and 4 percent soils of minor extent. Cloverlick, Helechawa, Jefferson, Renox, and Sharondale soils are similar soils in this map unit.

The deep and very deep, well drained Kimper soils are on mountains. Typically, the surface layer is dark brown silt loam. The subsoil is dark yellowish brown silt loam in the upper part and brown channery silty clay loam in the lower part. Beneath this is bedrock.

The deep and very deep, well drained Shelocta soils are on mountains. Typically, the surface layer is channery silt loam. It is dark grayish brown in the upper part and dark yellowish brown in the lower part. The subsoil is yellowish brown channery clay loam and silty clay loam.

The deep and very deep, somewhat excessively drained Varilla soils are on mountains. Typically, the surface layer is very dark grayish brown gravelly fine sandy loam. The subsoil is yellowish brown gravelly fine sandy loam in the upper part, yellowish brown very cobbly and extremely cobbly fine sandy loam in the next part, and yellowish brown extremely cobbly loamy sand in the lower part.

Of minor extent are the gently sloping to very steep Bethesda and Fairpoint soils in surface-mined areas and the sloping and moderately steep Highsplint and Jefferson soils on foot slopes and alluvial fans.

Most areas of this map unit are used as woodland. A few areas along the base of the mountain have been cleared and are used for farming. The limestone has been quarried in a few places.

These soils are generally unsuitable for farming because of the slope, rockiness, and surface stoniness.

These soils are suited to woodland and to woodland wildlife habitat. Woodland productivity generally is high or moderate. Along the windswept summit, however, it is moderate or low. The most common tree species are sugar maple, yellow poplar, American beech, red maple, and chestnut oak. The main management concerns are the hazard of erosion, the equipment limitation, and plant competition.

In most areas these soils are unsuited to urban development because of the slope.

Nearly Level, Well Drained Soils That Have a Loamy Subsoil; on Flood Plains

These soils have a loamy surface layer and subsoil. They formed in alluvium or in fill material. They make up about 3 percent of Bell County and less than 1 percent of Harlan County. The kinds of soil and the major land uses vary.

Most areas are cleared and are used for pasture, hay, or row crops. Some areas are used for urban development. Flooding is the main hazard affecting most uses.

5. Udorthents-Shelbiana-Urban Land

Urban land and very deep, well drained soils

This map unit consists of urban land and nearly level soils in built-up areas on flood plains. Some areas are subject to flooding. Slopes range from 0 to about 2 percent.

This map unit makes up about 2 percent of Bell County and less than 1 percent of Harlan County. It is about 37 percent Udorthents and similar soils, 29 percent Shelbiana and similar soils, 13 percent Urban land, and 21 percent soils of minor extent.

Udorthents formed in fill material over natural soil.

The nearly level Shelbiana soils are on flood plains. Typically, the surface layer is very dark grayish brown loam. The subsoil is loam. It is dark brown in the upper part, brown in the next part, and yellowish brown and dark yellowish brown in the lower part.

Urban land is land covered by houses, streets, parking lots, buildings, and other structures.

Of minor extent are the nearly level Bonnie soils on flood plains, the gently sloping Allegheny soils on stream terraces, and the gently sloping to moderately steep Shelocta soils on foot slopes and alluvial fans. Also of minor extent are a few areas of water and other miscellaneous areas.

Most areas of the major soils are used as sites for dwellings and small commercial buildings. Many areas are protected by levees or other measures. Some are subject to flooding but are used for urban development because better suited soils are not plentiful in this survey area. A few areas are used for cultivated crops or for hay and pasture. Flooding is the main hazard if the Shelbiana soils are used as sites for dwellings, small commercial buildings, or septic tank absorption fields.

6. Shelbiana

Very deep, well drained soils that are subject to flooding

This map unit consists of nearly level soils on flood plains along the Cumberland River. These soils are occasionally flooded. Slopes range from 0 to 2 percent.

This map unit makes up about 1 percent of Bell county and less than 1 percent of Harlan County. It is about 65 percent Shelbiana and similar soils and 35 percent soils of minor extent.

The nearly level Shelbiana soils are on flood plains. Typically, the surface layer is very dark grayish brown loam. The subsoil is loam. It is dark brown in the upper part, brown in the next part, and yellowish brown and dark yellowish brown in the lower part.

Of minor extent are the gently sloping to moderately steep Allegheny, Gilpin, and Shelocta soils on stream terraces, foot slopes, and alluvial fans.

Most areas of this map unit are used for pasture and hay. Some are used for corn or gardens. A few are used for building site development.

These soils are well suited to cultivated crops, such as corn and tobacco, to the garden crops commonly grown in the survey area, and to grasses and legumes for hay and pasture. They are suited to openland wildlife habitat. The main concerns in managing cultivated areas are the hazard of flooding, measures that maintain tilth and fertility, and the susceptibility to compaction. The main concerns in managing pasture and hayland are preventing overgrazing and maintaining a good stand. Also, flooding is a hazard.

These soils are generally unsuited to urban development because of the hazard of flooding.

Sloping to Steep, Well Drained Soils That Have a Loamy Subsoil; on Hills

These are very deep to moderately deep soils that have a loamy surface layer and subsoil. The soils formed in material weathered from siltstone, shale, and sandstone. The underlying bedrock is of Pennsylvanian age. The soils make up about 3 percent of Bell County. They do not occur in Harlan County.

7. Shelocta-Gilpin

Very deep to moderately deep soils; on hills with relief of 80 to 240 feet

This map unit consists of soils on low hills in the vicinity of Middlesboro and Frakes. The hills are surrounded by mountains that are 700 to 1,000 feet higher in elevation. The landscape is dissected by numerous small drainageways. Ridgetops are narrow and are sloping or moderately steep. Side slopes are moderately steep or steep. Elevations range from 1,160 to about 1,600 feet. In most areas slopes range from 6 to about 35 percent.

This map unit makes up about 3 percent of Bell County. It is about 32 percent Shelocta and similar soils, 28 percent Gilpin and similar soils, and 40 percent minor soils.

The deep and very deep, well drained Shelocta soils are on hills. Typically, the surface layer is silt loam. It is brown in the upper part and yellowish brown in the lower part. The subsoil is yellowish brown silty clay loam, channery silt loam, and channery loam. Beneath this is siltstone bedrock.

The moderately deep, well drained Gilpin soils are on hills. Typically, the surface layer is silt loam. It is very dark grayish brown in the upper part and yellowish brown in the lower part. The subsoil is brownish yellow silty clay loam. Beneath this is siltstone bedrock.

Of minor extent are the very steep Highsplint and Kimper soils on mountainous ridges; the gently sloping to steep Udorthents; the nearly level Bonnie, Philo, and Pope soils on flood plains; the gently sloping Allegheny soils on stream terraces; and Fairpoint and Bethesda soils in areas that have been surface mined for coal.

Many areas of this map unit are used for building site development. Some are used as pasture or woodland.

The sloping areas of these soils are suited to cultivated crops, such as corn. The moderately steep areas are only marginally suited because of the hazard of erosion, and the steep areas are generally unsuited because of the slope and the hazard of erosion. The main concerns in managing cultivated areas are controlling erosion and maintaining fertility and tilth.

These soils are suited to grasses and legumes. The main concerns in managing pasture and hayland are preventing overgrazing and maintaining a good stand.

These soils are suited to woodland. Productivity is moderate. The main management concerns are the hazard of erosion, the equipment limitation, and plant competition.

Many areas of these soils are suited to building site development, but the steeper areas generally are unsuited unless they are extensively graded. The main limitation on sites for dwellings without basements is the slope. In some areas the depth to bedrock is a limitation on sites for dwellings with basements. The main limitations on sites for septic tank absorption fields are the depth to bedrock and the slope. Restricted permeability is a limitation in some areas.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Crossville loam, 3 to 12 percent slopes, is a phase of the Crossville series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Shelocta-Highsplint complex, 35 to 75 percent slopes, very stony, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Fairpoint and Bethesda soils, 2 to 20 percent slopes, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Urban land is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 5 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils.

AgB—Allegheny loam, 2 to 8 percent slopes. This very deep, well drained, gently sloping soil is on stream terraces and alluvial fans. In most areas the elevations range from about 1,000 to 1,600 feet. Slopes are smooth. Most areas are nearly oval and range from about 6 to 60 acres in size.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil extends to a depth of about 60 inches. It is light yellowish brown loam and light olive brown clay loam in the upper part; yellowish brown and strong brown clay loam in the next part; and yellowish brown, mottled clay loam in the lower part.

This soil is low in natural fertility and moderate in organic matter content. The available water capacity is high. Permeability is moderate. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 14 inches. The depth to bedrock is 60 inches or more.

Included in this map unit are small areas of Shelocta and Jefferson soils. These soils make up about 10 percent of the unit.

Most areas are used as pasture. Many areas that previously were cleared for farming have reverted to woodland. A few areas are used for cultivated crops or gardens.

This soil is well suited to cultivated crops, such as corn and tobacco, and to the garden crops commonly grown in the survey area. The main management concerns are keeping erosion to a minimum and maintaining tilth and fertility. In some areas runoff from the adjacent mountain slopes can cause gully erosion or can deposit gravel. This runoff can be removed by diversion terraces or by grassed waterways. Terraces, conservation tillage, and a crop rotation that includes grasses and legumes help to control erosion. No limitations affect terracing. A crop rotation in which grasses and legumes are grown in about 1 out of every 4 years is needed to control erosion in most areas. A system of conservation tillage can be applied in many areas where crops are grown year after year. Conservation tillage and cover crops help to maintain good tilth and fertility.

This soil is suited to grasses and legumes. It is best suited to tall fescue, lespedeza, and other forage species that are tolerant of an acid, infertile subsoil. If lime and fertilizer are applied, however, good yields can be obtained from most forage species. The main management concerns are preventing overgrazing and maintaining a good stand. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

This soil is suited to trees. Productivity is moderate. In an average stand that is fully stocked, yellow poplar can reach a height of about 93 feet in 50 years. Plant competition is the major management concern. It can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

The potential for openland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, water, nesting areas, and den sites. Field borders are good wildlife areas. Trees and shrubs in small areas and along fence rows can break up large open areas and provide food and cover for wildlife. The habitat in areas of native plants can be improved by disking and applying fertilizer. Brush piles or other nesting sites are needed.

This soil is suited to building site development. No limitations affect dwellings without basements.

The capability subclass is IIe.

AtF—Alticrest-Totz-Helechawa complex, rocky, 20 to 55 percent slopes. These shallow to very deep, somewhat excessively drained soils are on the southeast-facing side of Pine Mountain and the northwest-facing side of Cumberland Mountain. They are on the irregular ridges that separate the larger streams. Slopes are steep or very steep. The elevations along the mountain crests range from about 2,000 to 3,400 feet. The higher elevations have more snow and ice during the winter than the lower elevations and may receive more rainfall during the summer. Near the base of the mountain, the elevations are 1,000 to 1,600 feet. The shape of the downward slope of the mountain is very irregular. Convex or linear slopes are broken by knolls or cliffs. Saddles are upslope from the knolls and cliffs. Across the slope, the shape ranges from almost linear to strongly convex. Small concave areas are at the head of drainageways. Rock outcrops are on many of the knolls. The rock outcrops and cliffs make up about 2 percent of the unit. Stones and boulders cover less than 3 percent of the surface in most places. Most areas are long and narrow and range from 40 to 600 acres in size.

In a typical area the composition is as follows: Alticrest and similar soils—35 percent; Totz and similar soils—20 percent; Helechawa and similar soils—20 percent; and contrasting inclusions—25 percent. The moderately deep Alticrest soil is on steep ridgetops. The shallow Totz soil commonly is near the areas of rock outcrop. The deep and very deep Helechawa soil is on side slopes. The soils in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Alticrest soil has a surface layer of very dark grayish brown fine sandy loam about 2 inches thick. The subsoil is about 31 inches thick. It is yellowish brown. It is fine sandy loam in the upper part, loam in the next part, and gravelly fine sandy loam in the lower part. Sandstone bedrock is at a depth of about 33 inches. In some areas the soil has a dark surface layer and is on cool slopes or at the higher elevations.

Typically, the Totz soil has a surface layer of dark grayish brown fine sandy loam about 2 inches thick. The subsurface layer is yellowish brown fine sandy loam about 5 inches thick. The subsoil is loamy fine sand about 11 inches thick. It is yellowish brown in the upper part and strong brown in the lower part. Sandstone bedrock is at depth of about 18 inches. In some areas the soil is 6 to 10 inches deep over bedrock. In a few areas the subsoil contains 35 to 50 percent rock fragments.

Typically, the Helechawa soil has a surface layer of very dark grayish brown sandy loam about 5 inches thick. The subsoil is yellowish brown sandy loam about 44 inches thick. The substratum to a depth of about 63 inches is strong brown loamy sand. Sandstone bedrock is at a depth of about 63 inches. In some areas the soil has a dark surface layer and is on cool slopes or at the higher elevations.

These soils are low in natural fertility. The organic matter content is low in the Alticrest and Totz soils and moderate in the Helechawa soil. In the Alticrest and Helechawa soils, the available water capacity is moderate and permeability is moderately rapid. In the Totz soil, the available water capacity is very low and permeability is rapid. The number of roots decreases gradually with increasing depth in the Alticrest and Helechawa soils, and there are few roots below a depth of about 18 inches. In the Totz soil, bedrock at a depth of about 18 inches limits root penetration. The depth to bedrock ranges from 10 to 20 inches in the Totz soil, from 20 to 40 inches in the Alticrest soil, and from 40 to more than 60 inches in the Helechawa soil.

Included in this map unit are small areas of Varilla, Sequoia, Shelocta, and Gilpin soils. Varilla soils are on the lower side slopes. Shelocta, Gilpin, and Sequoia soils are in saddles and on side slopes. They are underlain by shale bedrock. Included soils make up about 20 percent of the unit.

Most areas are used as woodland. Part of the acreage is in state forests, state parks, and the Cumberland Gap National Historical Park.

These soils are suited to trees. Productivity ranges from low to high, depending on the depth to bedrock and other site characteristics. In an average stand that is fully stocked, scarlet oak or Virginia pine on the Alticrest soil can reach a height of about 60 feet in 50 years. Some of the more common tree species are chestnut oak, scarlet oak, black oak, white oak, and Virginia pine. In some areas these species are mixed with red maple, pitch pine, sourwood, hickories, and numerous species of minor extent. Where adjacent to streams and sheltered by cliffs, the forest is mainly eastern hemlock and a dense understory of rhododendron. Many abandoned fields have reverted to nearly pure stands of yellow poplar or Virginia pine. Some of the fields have been planted to pine. The most common understory plants are mountain laurel, vaccinium, greenbrier, sumac, sassafras, sourwood, and trailing arbutus. The herbaceous flora is sparse but includes a number of species commonly associated with dry ridgetops.

The hazard of erosion, the equipment limitation, seedling mortality, and the windthrow hazard are the major concerns in managing woodland. Erosion is a hazard along haul roads and skid trails. This hazard can be reduced by establishing a grade of less than 10 percent along the roads and trails and by limiting the area of surface disturbance to 10 percent or less. Permanent access roads can be protected by water breaks, culverts, and gravel. In many areas the roads and trails cannot be built along the ridgetops because of cliffs. Because of the slope, crawler tractors or other specialized equipment generally is needed. Logs can be yarded to roads and trails built on the contour. Trees can be planted by hand or by direct seeding methods. The seedling mortality rate is increased by the shallow rooting depth in the Totz soil. Trees in areas of the Totz soil and in some areas of the Alticrest soil are likely to be uprooted during high winds because the rooting depth is limited by the underlying bedrock. The stands in areas of these soils should be thinned less intensively and more frequently than those in areas where windthrow is less likely. Table 8 gives additional information about woodland management and productivity.

The potential for woodland wildlife habitat is very poor to fair. The habitat can be improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Den trees should not be harvested. Brush piles or other nesting sites are needed.

These soils generally are unsuitable for cultivated crops, pasture, and building site development because of the slope.

The capability subclass is VIIe.

Bo—Bonnie silt loam, occasionally flooded. This very deep, poorly drained, nearly level soil is on flood plains along small streams. Slopes are 0 to 1 percent. Most areas are nearly oval and range from about 6 to 40 acres in size.

Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsoil is light brownish gray, mottled silt loam about 20 inches thick. The substratum to a depth of about 60 inches also is light brownish gray, mottled silt loam. In some areas the substratum is medium acid or slightly acid. In other areas the content of fine sand and sand is 15 to 30 percent.

This soil is medium in natural fertility and low in organic matter content. Permeability is moderately slow. The available water capacity is high. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 12 inches. The depth to bedrock is 60 inches or more. Most areas are occasionally flooded. The frequency of flooding ranges from about once in 2 years to once in 50 years. The floods are of brief duration. A water table is within a depth of 1 foot late in winter and in spring.

Included in this map unit are small areas of Philo and Pope soils. Philo soils are moderately well drained and are in areas throughout the unit. Pope soils are well drained and are on natural levees or in other areas adjacent to the stream channels. Included soils make up about 15 percent of the unit.

Most areas are used for pasture and hay. Many areas that previously were cleared and used as pasture have reverted to woodland.

If drained, this soil is suited to cultivated crops, such as corn. In undrained areas, however, it generally is unsuited. Even in drained areas, it commonly remains too wet to plow for several days longer than the better drained soils in the survey area. Late planting is common. Other management concerns are flooding and measures that maintain tilth and fertility. Where summer crops, such as corn, are grown, flooding generally does not interfere with fieldwork or damage the crop. Tilth is good. Conservation tillage, cover crops, and applications of lime and fertilizer help to maintain good tilth and fertility.

This soil is suited to grasses and legumes. It can be used for tall fescue, reed canarygrass, big bluestem, ladino clover, and other forage species that are tolerant of wetness. Reed canarygrass grows exceptionally well in the wettest areas because it is tolerant of standing water. Both tall fescue and reed canarygrass form a sod firm enough for cattle to graze without excessive miring. Measures that prevent overgrazing and maintain a good stand are needed. Overgrazing weakens the stand and allows undesirable plants to grow. Rushes and sedges are common in overgrazed areas and in unimproved areas. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

This soil is suited to trees. Productivity is moderate. In an average stand that is fully stocked, pin oak can reach a height of about 96 feet in 50 years. In unmanaged wooded areas, stands of alder and willow are common. The main management concerns are the equipment limitation, the windthrow hazard, and plant competition. The seedling mortality rate can be high because of standing water and the high water table. A desirable stand can be established through reinforcement planting, or the soil can be ridged and the seedlings planted on the ridges. Excessive rutting or miring can occur when the soil is wet. The use of equipment can be delayed until the soil is dry. Gravel or other suitable material can be added to the main logging roads to reduce the extent of rutting and miring. If possible, roads should be built on nearby soils that are less prone to rutting and miring. Plant competition can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by site preparation and planting. Windthrow is a hazard because of the water table. The stands in areas of this soil should be thinned less intensively and more frequently than those in areas where the hazard of windthrow is slight. Table 8 gives additional information about woodland management and productivity.

The potential for wetland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites.

This soil generally is unsuited to building site development unless the guidelines for building on a flood plain are followed. Wetness is a severe limitation.

The capability subclasses are Vw in undrained areas and IIw in drained areas.

CgF—Cloverlick-Guyandotte-Highsplint complex, 35 to 75 percent slopes, very stony. These deep and very deep, well drained, very steep soils are on the cool slopes on mountainsides. The elevations range from about 3,000 feet near the mountain crest to 1,400 feet along the base of the mountain. The higher elevations have more snow and ice during the winter than the lower elevations and may receive more rainfall during the summer. The downward slope of the mountain is nearly linear, except where broken by small cliffs or benches. Only a slight flattening of the slope occurs near the top and bottom of the mountain. Across the mountain the slope is distinctly corrugated. Small streams in the grooves commonly begin near the mountain crest and run almost to the base of the mountain before joining other streams. In most places the streams are about 300 to 600 feet apart. Areas between the streams are characterized by sharp-crested ribs that have fairly smooth slopes. Stones and boulders generally cover about 0.1 to 15.0 percent of the surface. They cover as much as 70 percent of the surface, however, in some ravines and in areas below some cliffs. In places sandstone layers form cliffs. Most areas are nearly rectangular and range from about 60 to 2,500 acres in size.

In a typical area the composition is as follows: Cloverlick and similar soils—45 percent; Guyandotte and similar soils—20 percent; Highsplint and similar soils—20 percent; and contrasting inclusions—15 percent. The soils in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Cloverlick soil has a surface layer of very dark gray gravelly loam about 6 inches thick. The subsoil extends to a depth of about 70 inches. The upper part is brown and yellowish brown gravelly loam, the next part is yellowish brown very gravelly loam, and the lower part is yellowish brown very flaggy loam. In some areas the subsoil contains 20 to 35 percent rock fragments.

Typically, the Guyandotte soil has a surface layer of very channery loam about 17 inches thick. This layer is very dark grayish brown in the upper part and dark brown in the lower part. The upper part of the subsoil is dark yellowish brown very channery loam. The lower part to a depth of about 61 inches is yellowish brown very channery loam. In some areas the subsoil contains 20 to 35 percent rock fragments.

Typically, the Highsplint soil has a surface layer of very dark grayish brown very channery loam about 3 inches thick. The subsoil to a depth of about 60 inches is yellowish brown very channery loam. In some areas the subsoil contains 20 to 35 percent rock fragments.

These soils are low in natural fertility. The organic matter content is high in the Cloverlick and Guyandotte soils and moderate in the Highsplint soil. The available water capacity is moderate in all three soils. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. Permeability is moderate in the Cloverlick and Guyandotte soils and moderate or moderately rapid in the Highsplint soil. The depth to bedrock is 48 to more than 60 inches in the Cloverlick and Highsplint soils and 60 inches or more in the Guyandotte soil.

Included in this map unit are areas of Kimper, Cutshin, and Shelocta soils and loamy soils that are less than 36 inches deep over bedrock. These soils make up about 10 percent of the unit. Kimper, Cutshin, and Shelocta soils are in landscape positions similar to those of the Cloverlick, Guyandotte, and Highsplint soils. Also included, commonly on ledges or cliffs, are areas of rock outcrop, which make up less than 1 percent of the unit.

Most areas are used as woodland. A few areas adjacent to the stream valleys have been cleared and are used as unimproved pasture.

These soils are suited to trees. Productivity is high. In an average stand that is fully stocked, yellow poplar can reach a height of about 110 feet in 50 years. Under similar conditions, northern red oak can reach a height of about 85 feet. Some of the more common tree species in coves and on the lower slopes are sugar maple, yellow poplar, black locust, yellow buckeye, and American basswood. In some areas these species are mixed with northern red oak, red maple, white oak, chestnut oak, cucumbertree, American beech, eastern hemlock, black cherry, birches, magnolia, various hickories, and numerous species of minor extent. Many abandoned fields have reverted to nearly pure stands of yellow poplar. Some of the fields have been planted to eastern white pine or other pine species. The most common understory plants are flowering dogwood, American hornbeam, hydrangea, spicebush, grape, sassafras, buffalo nut, rhododendron, witchhazel, and vaccinium. The herbaceous flora is luxuriant and includes numerous species.

The hazard of erosion, the equipment limitation, and plant competition are the major concerns in managing woodland. Erosion is a hazard along haul roads and skid trails. This hazard can be reduced by establishing a grade of less than 10 percent along the roads and trails and by limiting the area of surface disturbance to 10 percent or less. Permanent access roads can be protected by water breaks, culverts, and gravel. Because of the slope, crawler tractors or other specialized equipment generally is needed. Logs can be yarded to roads and trails built on the contour. Trees can be planted by hand or by direct seeding methods. Plant competition can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

The potential for woodland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Den trees should not be harvested. Brush piles or other nesting sites are needed.

These soils generally are unsuitable for cultivated crops, pasture, and building site development because of the slope.

The capability subclass is VIIe.

Cr—Craigsville-Philo complex, occasionally flooded. These deep and very deep, well drained and moderately well drained, nearly level soils are on flood plains along small streams. Most areas are nearly oval and range from about 6 to 60 acres in size.

In a typical area the composition is as follows: Craigsville soils—55 percent; Philo soils—30 percent;

and contrasting inclusions—15 percent. The soils in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Craigsville soil has a surface layer of dark brown gravelly fine sandy loam about 9 inches thick. The subsoil is yellowish brown gravelly fine sandy loam about 11 inches thick. The substratum to a depth of about 60 inches is yellowish brown extremely gravelly loamy fine sand. In some areas the substratum contains more sand. In other areas the surface layer has a few rock fragments.

Typically, the Philo soil has a surface layer of dark brown fine sandy loam about 9 inches thick. The subsoil is dark yellowish brown, mottled fine sandy loam about 30 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, mottled silt loam. In some areas the subsoil has no mottles.

These soils are medium in natural fertility and moderate in organic matter content. Permeability is moderately rapid or rapid in the Craigsville soil and moderate in the Philo soil. The available water capacity is very low in the Craigsville soil and moderate in the Philo soil. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 60 inches or more in the Craigsville soil and 48 inches or more in the Philo soil. In late winter and in spring, a water table is at a depth of 1.5 to 3.0 feet in the Philo soil and at a depth of more than 4 feet in the Craigsville soil. Most areas are occasionally flooded. The frequency of flooding ranges from about once in 2 years to once in 100 years. The floods are of very brief duration.

Included in this map unit are small areas of Bonnie and Pope soils. These soils are in landscape positions similar to those of the Craigsville and Philo soils. Bonnie soils commonly occur as seepy or ponded areas. Included soils make up about 15 percent of the unit.

Most areas are used for pasture and hay. Some areas are used for corn, tobacco, or garden crops. A few areas that previously were cleared for farming have reverted to woodland.

These soils are suited to cultivated crops, such as corn, and to the garden crops commonly grown in the survey area. The main management concerns are flooding, the susceptibility to compaction, and measures that maintain tilth and fertility. Flooding generally does not interfere with fieldwork or damage the crop. Some areas are subject to the scouring and deposition caused by runoff from the adjacent mountain slopes. This runoff can be removed by diversion terraces or by grassed waterways. Tilth is good. In places the Craigsville soil contains excessive gravel in the plow layer. Conservation tillage, cover crops, and applications of lime and fertilizer help to maintain good tilth and fertility.

These soils are well suited to grasses and legumes. The hazard of flooding and measures that maintain fertility are the main management concerns. Measures that prevent overgrazing and maintain a good stand are needed. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

These soils are suited to trees. Productivity is high. In an average stand that is fully stocked, yellow poplar can reach a height of about 95 feet in 50 years. Some of the more common species are American sycamore and yellow poplar. Plant competition is the main management concern. It can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by clearing and disking, by applying herbicides, or by managing the existing stand. Table 8 gives additional information about woodland management and productivity.

The potential for openland wildlife habitat is fair or good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Field borders are good wildlife areas. Trees and brush along the streams provide benefits to wildlife as well as erosion control. Brush piles or other nesting sites are needed.

These soils generally are unsuited to building site development unless the guidelines for building on a flood plain are followed.

The Craigsville soil is in capability subclass IIIs, and the Philo soil is in capability subclass IIw.

CsC—Crossville loam, 3 to 12 percent slopes. This moderately deep, well drained, gently sloping and sloping soil is on the smooth crests of Brush and Cumberland Mountains (fig. 7). The elevations range from 2,700 to 3,400 feet. These high elevations have more snow and ice during the winter than lower elevations and may receive more rainfall during the summer. Slopes are convex and commonly are uniform. Most areas are nearly oval and range from about 70 to 150 acres in size.

Typically, the Crossville soil has a surface layer of dark brown loam about 7 inches thick. The subsoil is loam about 17 inches thick. It is dark yellowish brown in the upper part and yellowish brown in the lower part. Weakly cemented sandstone bedrock that can be dug with hand tools is at a depth of about 24 inches. Hard sandstone bedrock is at a depth of about 37 inches.

This soil is low in natural fertility and high in organic

Figure 7.—Favorable topography attracted settlers to this remote area on Cumberland Mountain. The area is part of Hensley Settlement, a restored pioneer community in Cumberland Gap National Historical Park. Crossville loam, 12 to 20 percent slopes, is in the foreground, and Crossville loam, 3 to 12 percent slopes, is on the ridgetop in the background.

matter content. Permeability is moderate. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The available water capacity is moderate. The depth to bedrock ranges from 20 to 40 inches.

Included in this map unit are small areas of Kimper, Totz, and Alticrest soils. These soils are in landscape positions similar to those of the Crossville soil. Also included is a moderately deep soil that has a subsoil of very gravelly fine sandy loam. Included soils make up about 15 percent of the unit.

Most areas are used as woodland. These areas generally are in the Cumberland Gap National Historical Park. Some areas have been cleared and are used for hay or corn.

This soil is suited to cultivated crops, such as corn, and to the garden crops commonly grown in the survey area. The main management concerns are keeping erosion to a minimum and maintaining tilth and fertility. A system of conservation tillage and a crop rotation that includes grasses and legumes help to control erosion. A crop rotation in which grasses and legumes are grown in about 3 out of every 4 years is needed to control erosion in most areas. A system of conservation tillage can increase the number of years when cultivated crops can be included in the rotation. Conservation tillage and cover crops help to maintain good tilth and fertility.

This soil is suited to grasses and legumes. It is best suited to forage species that are tolerant of an acid, infertile subsoil. If lime and fertilizer are applied, however, good yields can be obtained from most forage species. The main management concerns are preventing overgrazing and maintaining a good stand. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

This soil is suited to trees. Productivity is moderate. In an average stand that is fully stocked, Virginia pine can reach a height of about 60 feet in 50 years. Many abandoned fields have stands of Virginia pine. In some areas these species are mixed with sourwood, blackgum, and red maple. Plant competition is the main management concern. It can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by clearing and disking, by applying herbicides, or by managing the existing stand. Table 8 gives additional information about woodland management and productivity.

This soil is poorly suited to building site development unless sewer facilities are available. It generally is unsuited to septic tank absorption fields because of the depth to bedrock. In most places no limitations affect dwellings without basements.

The capability subclass is IIIe.

CsD—Crossville loam, 12 to 20 percent slopes. This moderately deep, well drained, moderately steep soil is on the smooth crests of Brush and Cumberland Mountains. The elevations range from 2,700 to 3,400 feet. These high elevations have more snow and ice during the winter than lower elevations and may receive more rainfall during the summer. Slopes are convex or linear and commonly are uniform. Most areas are nearly oval and range from about 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown and brown loam about 8 inches thick. The subsoil is yellowish brown loam about 20 inches thick. Sandstone bedrock is at a depth of 28 inches.

This soil is low in natural fertility and high in organic matter content. Permeability is moderate. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The available water capacity is moderate. The depth to bedrock ranges from 20 to 40 inches.

Included in this map unit are small areas of Kimper, Totz, and Alticrest soils. These soils are in landscape positions similar to those of the Crossville soil. Also included is a moderately deep soil that has a subsoil of very gravelly fine sandy loam. Included soils make up about 15 percent of the unit.

Most areas are used as woodland. Some areas have been cleared and are used as pasture. Most of this map unit is in the Cumberland Gap National Historical Park.

This soil is poorly suited to cultivated crops, such as corn, unless intensive erosion-control measures are used. Another management concern is maintaining tilth and fertility.

This soil is suited to grasses and legumes. It is best suited to tall fescue, white clover, and other forage species that are tolerant of an acid, infertile subsoil. If lime and fertilizer are applied, however, good yields can be obtained from most forage species. The main management concerns are preventing overgrazing and maintaining a good stand. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

This soil is suited to trees. Productivity is moderate. In an average stand that is fully stocked, Virginia pine can reach a height of about 60 feet in 50 years. Many abandoned fields have stands of Virginia pine. In some areas these species are mixed with sourwood, blackgum, and red maple. Plant competition is the main management concern. It can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by clearing and disking, by applying herbicides, or by managing the existing stand. Table 8 gives additional information about woodland management and productivity.

This soil is poorly suited to building site development unless sewer facilities are available. It generally is unsuited to septic tank absorption fields because of the depth to bedrock and the slope. The slope is a limitation on sites for dwellings without basements.

The capability subclass is IVe.

Du—Dumps, mine; tailings; and tipples. This map unit consists of the residue of coal mining. The mine dumps, or "gob piles," are heaps of coal that contain too many impurities to be of commercial value. Commonly, the heaps are steep, flat-topped hills about 100 feet high. The tailings are finely pulverized coal and shale washed from the mined coal during preparation and then deposited in basins or tailing ponds. Tipples are coal-loading areas. They include large piles of coal and loading and storage facilities. Commonly, each miscellaneous area is large enough to be mapped separately. Because of present and predicted uses, however, they were mapped as one unit. Most delineations contain each of these miscellaneous areas, but many contain two or only one of these areas. The material shows no evidence of alteration by soil-forming processes. Most areas are nearly oval and range from about 8 to 80 acres in size.

The mine dumps commonly consist of very dark grayish brown or black channers. The content of rock fragments commonly ranges, by volume, from 75 to 95 percent. The fragments are about 1/12 inch to 6 inches long. The mine dumps include heaps of "red dog," or the residue of impure coal that has burned.

The tailings consist of sand-sized black material, which generally is finely pulverized coal. The material is washed from coal and is allowed to settle in basins. Most of the material would pass through a 100-mesh screen.

The tipples are coal-loading areas. They include large piles of coal; processing, loading, and storage facilities; buildings; and parking areas.

Included in this map unit are small areas of Bethesda and Fairpoint soils and other Udorthents. These soils are in landscape positions similar to those of the Dumps. Udorthents formed in loamy fill material. Included soils make up about 15 percent of the unit.

These areas generally support no vegetation or a sparse cover of grasses, forbs, and small trees. The main limitations affecting the establishment of vegetation are high acidity, droughtiness, and very low fertility. In places a high content of rock fragments in the surface layer or the slope is a limitation. The steeper areas can be smoothed. Applying lime and fertilizer, mulching, and selecting species that are suited to acid, droughty soil material can help to establish a plant cover. Some areas can be topdressed with soil material that is better suited to plants.

The capability subclass is VIIIs.

FbC—Fairpoint and Bethesda soils, 2 to 20 percent slopes. These very deep, well drained, gently sloping to moderately steep soils are on ridges and mountains. Most areas have been surface mined for coal. Some have been altered by highway construction or other extensive earthmoving. Stones and boulders cover about 0.01 to 3.0 percent of the surface in some areas. Most areas are long and narrow or are irregular in shape. They are 6 to 200 acres in size.

In a typical area, about 90 percent of the acreage is the Fairpoint soil, the Bethesda soil, or both and 10 percent is contrasting inclusions. Individual areas of each soil are large enough to be mapped separately. Because of the present and predicted uses, however, the soils were mapped as one unit. Many areas contain both soils, but some contain only one of the soils.

Typically, the Fairpoint soil has a surface layer of dark olive gray channery silt loam about 3 inches thick. The subsurface layer is dark olive gray extremely channery silt loam about 7 inches thick. The substratum to a depth of about 60 inches is dark olive gray and olive gray extremely channery silt loam. In some areas the substratum contains 15 to 35 percent rock fragments. In other areas the surface layer contains more clay or more sand.

Typically, the Bethesda soil has a surface layer of dark grayish brown very channery loam about 7 inches thick. The subsurface layer is grayish brown very channery silt loam about 5 inches thick. The substratum to a depth of about 60 inches is yellowish brown very channery loam and extremely channery silt loam. In some areas the substratum contains 15 to 35 percent rock fragments. In other areas the surface layer contains more clay or more sand.

These soils are low in natural fertility and in organic matter content. Permeability is moderately slow. The available water capacity is moderate. The depth to bedrock is 60 inches or more.

Included in this map unit are small areas of soils that have not been disturbed by surface mining. Also included are shallow, loamy soils in surface-mined areas; ponded or seepy areas; soils that have a pH of 3.0 to 3.6; rock escarpments, mine dumps, and water; and some areas where runoff concentrates and gullies form. Included areas make up about 10 percent of the unit.

Most areas have been smoothed and seeded to various grasses, legumes, and trees. Some areas are used as pasture.

These soils generally are unsuited to cultivated crops, such as corn and soybeans. The main limitations are the hazard of erosion and the rock fragments in the surface layer.

These soils are suited to grasses and legumes. They are best suited to the forage species that are tolerant of drought and a wide range of acidity. Tall fescue and sericea lespedeza have been grown successfully. In most areas the pH ranges from 4.8 to 6.5, but in places it is as low as 3.6 or as high as 7.5. Where a higher pH is desired, lime can be added. Most areas require 2 to 5 tons of lime to raise the pH to about 6.5. The amount to be applied should be based on the results of soil tests and the quality of the lime. The supply of phosphorus generally is very low. This nutrient commonly is needed for successful seeding. Potassium levels generally are low or medium and commonly are adequate for cover mixtures. Other limitations affecting grasses and legumes are compacted layers and a high content of rock fragments.

These soils are suited to trees. Productivity is moderate. In an average stand that is fully stocked, loblolly pine on the Fairpoint soil can reach a height of about 74 feet in 50 years. On the Bethesda soil, a similar stand can reach a height of 69 feet. Seedling mortality and plant competition are the main management concerns. Erosion is a hazard unless the surface is protected by a plant cover. Seeding herbaceous species along with the tree species helps to control erosion. Mulching with straw or processed wood fiber also helps to control erosion. In many areas the seed, fertilizer, and mulch are applied as a slurry. The tree species suitable for seeding are black locust, eastern white pine, loblolly pine, yellow poplar, and white oak. Table 8 gives additional information about woodland management and productivity.

The potential for openland wildlife habitat is very poor. The habitat can be improved by providing food, cover, water, nesting areas, and den sites. Rows of trees and shrubs can break up large open areas. Mixtures of grasses and legumes can be planted for food and cover. The habitat in areas of native plants can be improved by disking and applying fertilizer. Shallow water areas can be established. Also, seasonal pools can be established in depressions. Brush piles or other nesting sites are needed.

These soils generally are unsuited to urban development because of the hazards of uneven settling, landslides, and slumps.

The capability subclass is VIs.

FbF—Fairpoint and Bethesda soils, 20 to 70 percent slopes. These very deep, well drained, steep to very steep soils are on ridges and mountains. Most areas have been surface mined for coal (fig. 8). Some have been altered by highway construction or other extensive earthmoving. The dominant slopes are 20 to 70 percent, but many areas have a narrow bench where the slopes are 0 to 20 percent. Stones and boulders cover about 0.01 to 3.0 percent of the surface in some areas. Most areas are long and narrow or are irregular in shape. They are 10 to 200 acres in size.

In a typical area, about 80 percent of the acreage is the Fairpoint soil, the Bethesda soil, or both and 20 percent is contrasting inclusions. Individual areas of each soil are large enough to be mapped separately. Because of the present and predicted uses, however, the soils were mapped as one unit. Many areas contain both soils, but some contain only one of the soils.

Typically, the Fairpoint soil has a surface layer of dark gray and dark grayish brown very channery silt loam about 11 inches thick. The substratum to a depth of about 60 inches is dark gray and dark grayish brown very channery silt loam. In some areas the substratum contains 15 to 35 percent rock fragments. In other areas the surface layer contains more clay or more sand.

Typically, the Bethesda soil has a surface layer of yellowish brown very channery loam about 5 inches thick. The subsurface layer is grayish brown very channery silt loam about 7 inches thick. The substratum to a depth of about 60 inches is yellowish brown very channery silt loam or extremely channery silt loam. In some areas the substratum contains 15 to 35 percent rock fragments. In other areas the surface layer contains more clay or more sand.

These soils are low in natural fertility and in organic matter content. Permeability is moderately slow. The available water capacity is moderate. The depth to bedrock is 60 inches or more.

Included in this map unit are small areas of soils that have not been disturbed by surface mining. Also included are shallow, loamy soils in surface-mined areas; ponded or seepy areas; soils that have a pH of 3.0 to 3.6; and rock escarpments, mine dumps, and water. Included areas make up about 20 percent of the unit.

Most areas have been smoothed and seeded to various grasses, legumes, and trees. A few areas were not planted but have reverted to various grasses, forbs, and trees. A few areas are used as pasture.

These soils generally are unsuited to cultivated crops, such as corn and soybeans. The main limitations are the slope and the rock fragments in the surface layer.

These soils are suited to grasses and legumes. They are best suited to forage species that are tolerant of drought and a wide range of acidity. Tall fescue and sericea lespedeza have been grown successfully. In most areas the pH ranges from 4.8 to 6.5, but in places it is as low as 3.6 or as high as 7.5. Where a higher pH is desired, lime can be added. Most areas require 2 to 5 tons of lime to raise the pH to about 6.5. The amount to be applied should be based on the results of soil tests and the quality of the lime. The supply of phosphorus generally is very low. This nutrient commonly is needed for successful seeding. Potassium levels generally are low or medium and commonly are adequate for cover mixtures. Other limitations affecting grasses and legumes are the slope, compacted layers, and a high content of rock fragments.

These soils are suited to trees. Productivity is moderate. In an average stand that is fully stocked, loblolly pine on the Fairpoint soil can reach a height of about 74 feet in 50 years. On the Bethesda soil, a similar stand can reach a height of 69 feet.

The hazard of erosion, the equipment limitation, and plant competition are the major concerns in managing

Figure 8.—A narrow area of Fairpoint and Bethesda soils, 20 to 70 percent slopes, that has been surface mined for coal. This area divides the mountain crest from the mountainsides. Gilpin-Shelocta-Sequoia complex, 25 to 55 percent slopes, very stony, is on the mountain crest. Shelocta-Highsplint complex, 35 to 75 percent slopes, very stony, is on the mountainsides.

woodland. Seedling mortality is an additional concern on the warm slopes. Erosion is a hazard along logging roads and trails. A protective plant cover is needed. Seeding herbaceous species along with the tree species helps to control erosion. Mulching with straw or processed wood fiber also helps to control erosion. Because of the slope, hand seeding or special seeding equipment may be needed. In many areas the seed, fertilizer, and mulch are applied as a slurry. The tree species suitable for seeding are black locust, eastern white pine, loblolly pine, yellow poplar, and white oak. Table 8 gives additional information about woodland management and productivity.

The potential for openland wildlife habitat is very poor. The habitat can be improved by providing food, cover, water, nesting areas, and den sites. Rows of trees and shrubs can break up large open areas. Mixtures of grasses and legumes can be planted for food and cover. The habitat in areas of native plants can be improved by disking and applying fertilizer. Shallow water areas can be established. Also, seasonal pools can be established in depressions. Brush piles or other nesting sites are needed.

These soils generally are unsuited to urban development because of the slope and the hazards of uneven settling, landslides, and slumps.

The capability subclass is VIIe.

GsC—Gilpin-Shelocta silt loams, 3 to 12 percent slopes. These moderately deep to very deep, well drained, gently sloping and sloping soils are on low hills and mountains. In most areas the elevations range from about 1,000 to 1,600 feet, but some areas on rounded mountain summits are at an elevation of about 2,000 feet. Most areas are irregular in shape and range from about 5 to 30 acres in size.

In a typical area the composition is as follows: Gilpin and similar soils—45 percent; Shelocta and similar soils—40 percent; and contrasting inclusions—15 percent. Most areas of the Gilpin soil are on the small summit slopes. Commonly, the Shelocta is on side slopes. The soils in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Gilpin soil has a surface layer of brown silt loam about 8 inches thick. The subsoil is yellowish brown silt loam about 18 inches thick. Siltstone bedrock is at a depth of about 26 inches.

Typically, the Shelocta soil has a surface layer of silt loam about 9 inches thick. The upper part of this layer is dark grayish brown, and the lower part is brown. The subsoil to a depth of about 60 inches is strong brown loam and light yellowish brown silty clay loam.

These soils are low in natural fertility and moderate in organic matter content. The available water capacity is moderate in the Gilpin soil and high in the Shelocta soil. Permeability is moderate in both soils. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock ranges from 20 to 40 inches in the Gilpin soil and is 48 inches or more in the Shelocta soil.

Included in this map unit are small areas of Sequoia soils and shallow, loamy soils. These soils make up about 15 percent of the unit. Also included are a few very small areas of rock outcrop, which make up less than 1 percent of the unit.

Most areas have been cleared and are used for pasture, hay or other crops, or building site development. A few areas that previously were cleared have reverted to woodland.

These soils are suited to cultivated crops, such as corn and tobacco, and to the garden crops commonly grown in the survey area. The main management concerns are keeping erosion to a minimum and maintaining tilth and fertility. Terraces, conservation tillage, and a crop rotation that includes grasses and legumes help to control erosion. Terraces are practical only on a very few fields because of the irregular slopes. Where terraces are used, the depth to bedrock is a limitation that can cause problems after construction. In determining the depth of cuts and the design of the terrace system, the possibility of exposing small infertile areas should be considered. A crop rotation in which grasses and legumes are grown in about 3 out of every 4 years is needed to control erosion in most areas. A system of conservation tillage can increase the number of years when cultivated crops can be included in the rotation. Conservation tillage and cover crops help to maintain good tilth and fertility.

These soils are suited to grasses and legumes. They are best suited to tall fescue, white clover, and other forage species that are tolerant of an acid, infertile subsoil. If lime and fertilizer are applied, however, good yields can be obtained from most forage species. The main management concerns are preventing overgrazing and maintaining a good stand. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

These soils are suited to trees. Productivity is moderate. In an average stand that is fully stocked, white oak can reach a height of about 75 feet in 50 years. Many abandoned fields have reverted to yellow poplar and red maple or have been planted to pine. Plant competition is the main management concern. It can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by clearing and disking, by applying herbicides, or by managing the existing stand. Table 8 gives additional information about woodland management and productivity.

These soils are poorly suited to building site development unless sewer facilities are available. The slope is a limitation on sites for dwellings without basements. Land shaping is needed. The soils are generally unsuited to septic tank absorption fields because of the depth to bedrock. The slope affects the ease of excavation and grading on sites for local roads and streets. Low strength affects the traffic-supporting capacity. Crushed rock or other suitable base material is needed.

The land capability subclass is IIIe.

GsD—Gilpin-Shelocta silt loams, 12 to 20 percent slopes. These moderately deep to very deep, well drained, moderately steep soils are on low hills and mountains. In most areas the elevations range from about 1,000 to 1,600 feet, but some areas on rounded mountain summits are at an elevation of about 2,000 feet. Most areas are irregular in shape and range from about 10 to 80 acres in size.

In a typical area the composition is as follows: Gilpin and similar soils—45 percent; Shelocta and similar soils—40 percent; and contrasting inclusions—15 percent. Most areas of the Gilpin soil are on the small summit slopes. Commonly, the Shelocta soil is on side slopes. The soils in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Gilpin soil has a surface layer of silt loam about 6 inches thick. The upper part of this layer is dark grayish brown, and the lower part is brownish yellow. The subsoil is channery silty clay loam about 22 inches thick. The upper part is strong brown, and the lower part is brownish yellow. Siltstone bedrock is at a depth of about 28 inches.

Typically, the Shelocta soil has a surface layer of silt loam about 12 inches thick. The upper part of this layer is very dark gray, and the lower part is yellowish brown. The subsoil is about 36 inches of strong brown silt loam and loam. Sandstone bedrock is at a depth of about 48 inches.

These soils are low in natural fertility and moderate in organic matter content. The available water capacity is moderate in the Gilpin soil and high in the Shelocta soil. Permeability is moderate. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 20 to 40 inches in the Gilpin soil and 48 inches or more in the Shelocta soil.

Included in this map unit are small areas of Sequoia soils and shallow, loamy soils. These soils make up about 15 percent of the unit. Also included are a few very small areas of rock outcrop, which make up less than 1 percent of the unit.

Most areas are used as pasture. Many areas that previously were cleared for farming have reverted to woodland. A few areas are used for cultivated crops or gardens.

These soils are poorly suited to cultivated crops, such as corn, unless intensive erosion-control measures are used. Another management concern is maintaining tilth and fertility.

These soils are suited to grasses and legumes. They are best suited to tall fescue, white clover, and other forage species that are tolerant of an acid, infertile subsoil. If lime and fertilizer are applied, however, good yields can be obtained from most forage species. The main management concerns are preventing overgrazing and maintaining a good stand. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

These soils are suited to trees. Productivity is moderate. Most abandoned fields have stands of yellow poplar and red maple or have been planted to eastern white pine or other pine. The hazard of erosion, the equipment limitation, and plant competition are the major concerns in managing woodland. Seedling mortality is an additional concern on the warm slopes. Erosion is a hazard along haul roads and skid trails. This hazard can be reduced by establishing a grade of less than 10 percent along the roads and trails and by limiting the area of surface disturbance to 10 percent or less. Where crawler tractors are used, as much as 10 percent of the area can be disturbed. Permanent access roads can be protected by water breaks, culverts, and gravel. Because of the slope, the equipment limitation generally applies only to large specialized harvesting and planting equipment. Commonly, the slopes are gentle enough for farming equipment and trucks to be used for harvesting and planting. In the small areas where slopes are steep, logs can be skidded to less sloping areas and planting can be done by hand. Plant competition can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

The potential for openland wildlife habitat is fair. The habitat can be improved by providing food, cover, water, nesting areas, and den sites. Field borders are good wildlife areas. Trees and shrubs in small areas and along fence rows can break up large open areas and provide food and cover for wildlife. The habitat in areas of native plants can be improved by disking and applying fertilizer. Brush piles or other nesting sites are needed.

These soils generally are poorly suited to building site development unless sewer facilities are available. The slope is the main limitation affecting dwellings without basements. Leveling is needed to modify the slope. The slope and the depth to bedrock are limitations on sites for septic tank absorption fields. The slope also affects the ease of excavating and grading on sites for local roads and streets.

The capability subclass is IVe.

GtF—Gilpin-Shelocta-Sequoia complex, 25 to 55 percent slopes, very stony. These moderately deep to very deep, well drained, steep and very steep soils are on ridgetops, mountain crests, and the upper side slopes in the mountains. In most areas the elevations range from about 1,800 to 2,200 feet and are about 600 to 800 feet above the valley floor. Stones and boulders cover 0.1 to 3.0 percent of the surface in most areas. Most areas are irregular in shape and range from about 15 to 300 acres in size.

In a typical area the composition is as follows: Gilpin and similar soils—30 percent; Shelocta and similar soils—25 percent; Sequoia and similar soils—15 percent; and contrasting inclusions—30 percent. Commonly, the Gilpin and Sequoia soils are on the small summit slopes. Most areas of the Shelocta soil are on side slopes. The soils in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Gilpin soil has a surface layer of loam about 9 inches thick. The upper part of this layer is very dark grayish brown, and the lower part is yellowish brown. The subsoil is yellowish brown channery loam about 27 inches thick. Siltstone bedrock is at a depth of about 36 inches. In some areas the soil has a thick, multicolored, loamy substratum.

Typically, the Shelocta soil has a surface layer of silt loam about 8 inches thick. The upper part of this layer is brown, and the lower part is yellowish brown. The subsoil is about 47 inches of yellowish brown channery loam and brownish yellow channery silt loam. Siltstone bedrock is at a depth of about 55 inches. In some areas the soil has a multicolored, loamy substratum below a depth of 36 inches. In other areas bedrock is at a depth of 40 to 48 inches.

Typically, the Sequoia soil has a surface layer of silt loam about 8 inches thick. The upper part of this layer is dark grayish brown, and the lower part is yellowish brown. The subsoil is strong brown silty clay about 24 inches thick. Weathered shale bedrock is at a depth of 32 inches, and siltstone bedrock is at a depth of about 48 inches. In some areas the subsoil has grayish mottles, which were inherited from the parent material. In other areas a multicolored, loamy substratum extends to a depth of about 48 inches.

These soils are low in natural fertility and moderate in organic matter content. The available water capacity is moderate in the Gilpin and Sequoia soils and high in the Shelocta soil. Permeability is moderate in the Gilpin and Shelocta soils and moderately slow in the Sequoia soil. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock ranges from 20 to 40 inches in the Gilpin and Sequoia soils and is 48 inches or more in the Shelocta soil. The shrink-swell potential is moderate in the Sequoia soil.

Included in this map unit are areas of Alticrest, Helechawa, Totz, and Varilla soils and shallow, channery soils on convex slopes. These soils make up about 20 percent of the unit. Alticrest, Helechawa, Totz, and Varilla soils commonly are on sandstone knobs but are throughout the unit. Also included are a few very small areas of rock outcrop, which make up less than 1 percent of the unit.

Most areas are used as woodland. A few areas are used as pasture.

These soils are suited to trees. Productivity is moderate. In an average stand that is fully stocked, chestnut oak can reach a height of about 68 feet in 50 years. Mixed oak forest is dominant. Some of the more common tree species are chestnut oak, black oak, scarlet oak, red maple, and white oak. In places these species are mixed with sugar maple, American beech, northern red oak, pitch pine, blackgum, and hickory. Many abandoned fields have reverted to nearly pure stands of Virginia pine or yellow poplar. The most common understory plants are mountain laurel, sassafras, flowering dogwood, American hornbeam, and greenbrier. The herbaceous flora is sparse, but numerous species are evident.

The hazard of erosion, the equipment limitation, and plant competition are the major concerns in managing woodland. Erosion is a hazard along haul roads and skid trails. This hazard can be reduced by establishing a grade of less than 10 percent along the roads and trails and by limiting the area of surface disturbance to 10 percent or less. Where crawler tractors are used, as much as 10 percent of the area can be disturbed. Permanent access roads can be protected by water breaks, culverts, and gravel. Because of the slope, crawler tractors or other specialized equipment generally is needed. Logs can be yarded to roads and trails built on the contour. Trees can be planted by hand or by direct seeding methods. Plant competition can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

The potential for woodland wildlife habitat is fair or good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Den trees should not be harvested. Brush piles or other nesting sites are needed.

These soils generally are unsuitable for cultivated crops, pasture, and building site development because of the slope.

The capability subclass is VIIe.

HeF—Helechawa-Varilla-Jefferson complex, very rocky, 35 to 75 percent slopes. These deep and very deep, somewhat excessively drained and well drained, very steep soils are on the southeast-facing side of Pine Mountain and the northwest-facing side of Cumberland Mountain. The soils are within the main ravines that deeply incise these mountains. They are dominantly on either southeast or northwest aspects but are on all aspects because of the irregularity of the slopes. The elevations near the mountain crests range from about 2,000 to 3,200 feet. The higher elevations have more snow and ice during the winter than the lower elevations and may receive more rainfall during the summer. Near the base of the mountain, the elevations are 1,000 to 1,600 feet. The slope into the ravines is linear or slightly concave, except where broken by small cliffs or ledges of sandstone. Across the slope, the shape is mainly linear but is broken by cliffs or ledges and small ravines. Most streams in the ravines flow all year and are fed by seeps and smaller streams. In places sandstone layers form cliffs. These cliffs and other areas of rock outcrop make up about 5 percent of the unit. Stones and boulders generally cover about 0.1 to 15.0 percent of the surface. They cover 15 to 70 percent of the surface in most areas of the Varilla soil. Most areas are long and narrow and range from 50 to 300 acres in size.

In a typical area the composition is as follows: Helechawa and similar soils—27 percent; Varilla and similar soils—27 percent; Jefferson and similar soils—20 percent; rock outcrop—5 percent; and contrasting inclusions—21 percent. The Helechawa and Jefferson soils are throughout this map unit. The Varilla soil is in the ravines, on the lower side slopes, and below cliffs. The soils in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Helechawa soil has a surface layer of very dark grayish brown and dark yellowish brown fine sandy loam about 6 inches thick. The subsoil is about 43 inches thick. It is yellowish brown. It is fine sandy loam in the upper part and gravelly fine sandy loam in the lower part. Sandstone bedrock is at a depth of about 49 inches. In some areas the soil has a dark surface layer and is on cool slopes or at the higher elevations.

Typically, the Varilla soil has a surface layer of very dark grayish brown gravelly fine sandy loam about 3 inches thick. The subsoil extends to a depth of about 64 inches. It is yellowish brown gravelly fine sandy loam in the upper part, yellowish brown very cobbly and extremely cobbly fine sandy loam in the next part, and yellowish brown extremely cobbly loamy sand in the lower part. In some areas the soil has a dark surface layer and is on cool slopes or at the higher elevations.

Typically, the Jefferson soil has a surface layer of brown loam about 6 inches thick. The subsoil to a depth of about 60 inches is yellowish brown loam in the upper part and yellowish brown gravelly loam in the lower part. In some areas the soil has a dark surface layer and is on cool slopes or at the higher elevations. In other areas the subsoil contains more silt and clay.

These soils are low in natural fertility. The organic matter content is moderate in the Helechawa and Jefferson soils and low in the Varilla soil. The available water capacity is moderate in the Helechawa soil, low in the Varilla soil, and high in the Jefferson soil. Permeability is moderately rapid in the Helechawa and Varilla soils and moderate or moderately rapid in the Jefferson soil. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 40 inches or more in the Helechawa soil, 48 inches or more in the Varilla soil, and 60 inches or more in the Jefferson soil.

Included in this map unit are small areas of Alticrest, Gilpin, Sequoia, and Totz soils; a soil that is similar to the Varilla soil but has bedrock at a depth of 20 to 40 inches; and a shallow, channery, loamy soil. Alticrest soils are throughout the map unit. Gilpin and Sequoia soils are on some benches. Totz soils are near areas of rock outcrop. Included soils make up about 21 percent of the unit.

Most areas are used as woodland. Part of the acreage is in state forests, state parks, and the Cumberland Gap National Historical Park.

These soils are suited to trees. Productivity is moderate. In an average stand that is fully stocked, white oak on the Helechawa soil can reach a height of about 70 feet in 50 years. Some of the more common tree species are white oak, American beech, yellow poplar, red maple, and numerous species of minor extent. Where adjacent to streams and sheltered by cliffs, the forest is mainly eastern hemlock and a dense understory of rhododendron (fig. 9). In some areas these species are mixed with chestnut oak, scarlet oak, red maple, blackgum, northern red oak, sugar maple, pitch pine, various hickories, and numerous species of minor extent. Many abandoned fields have reverted to nearly pure stands of yellow poplar or Virginia pine. Some of the fields have been planted to pine. The most common understory plants are rhododendron, flowering dogwood, American hornbeam, sassafras, sourwood, mountain laurel, and greenbrier. The herbaceous flora is moderately abundant and varied. Under the dense shade of rhododendron, partridgeberry is common.

The hazard of erosion, the equipment limitation, and plant competition are the major concerns in managing woodland. Erosion is a hazard along haul roads and skid trails. This hazard can be reduced by establishing a grade of less than 10 percent along the roads and trails and by limiting the area of surface disturbance to 10 percent or less. Permanent access roads can be protected by water breaks, culverts, and gravel. The

Figure 9.—An area of the Helechawa-Varilla-Jefferson complex, very rocky, 35 to 75 percent slopes. Forests of mostly eastern hemlock grow in the deepest parts of the ravines. The understory is mostly rhododendron.

layout of these roads is restricted in many places by cliffs. Because of the slope, crawler tractors or other specialized equipment generally is needed. Logs can be yarded to roads and trails built on the contour. Trees can be planted by hand or by direct seeding methods. Plant competition can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

The potential for woodland wildlife habitat is fair or good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Den trees should not be harvested. Brush piles or other nesting sites are needed.

These soils generally are unsuitable for cultivated crops, pasture, and building site development because of the slope.

The capability subclass is VIIe.

HgD—Highsplint very flaggy silt loam, 5 to 20 percent slopes, extremely bouldery. This deep and very deep, well drained, gently sloping to moderately steep soil is on the lower slopes of the larger mountains. The elevations range from about 1,500 to 2,000 feet. Stones and boulders cover about 5 to 40 percent of the surface. A few boulders are as large as 6 to 30 feet in diameter. Slopes are irregular. Most areas are nearly oval and range from about 8 to 50 acres in size.

Typically, the surface layer is very flaggy silt loam about 11 inches thick. It is dark brown in the upper 3 inches and yellowish brown in the lower part. The subsoil to a depth of about 60 inches is yellowish brown very flaggy loam in the upper part and yellowish red extremely flaggy loam in the lower part.

This soil is low in natural fertility and moderate in organic matter content. The available water capacity is moderate. Permeability is moderate or moderately rapid. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 48 inches or more.

Included in this map unit are small areas of Cloverlick, Guyandotte, and Shelocta soils. These soils are in landscape positions similar to those of the Highsplint soil. They make up about 10 percent of the unit.

Most areas are used as woodland. A few areas have been cleared and are used for pasture, cultivated crops, or building site development.

This soil generally is unsuited to cultivated crops and hay because of the amount of rock fragments on the surface. Small areas can be cleared of rocks and used for cultivated crops. The main management concerns in these areas are keeping erosion to a minimum and maintaining fertility.

In most areas this soil is poorly suited to grasses and legumes for pasture because of the amount of rock fragments on the surface. Areas that have fewer stones and boulders are better suited than other areas.

This soil is suited to trees. Productivity is moderate. In an average stand that is fully stocked, scarlet oak can reach a height of about 70 feet in 50 years. The equipment limitation and seedling mortality are management concerns. Harvesting equipment capable of operating on rough, bouldery terrain can be used. Roads and trails can be located around the larger rocks. Trees can be planted by hand or by direct seeding methods. Table 8 gives additional information about woodland management and productivity.

The potential for woodland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Den trees should not be harvested. Brush piles or other nesting sites are needed.

This soil is poorly suited to building site development. The main limitations are the slope and large stones and boulders. Roads, streets, and houses should be designed according to the slope. In places land shaping can modify the slope. Because of the slope, erosion is a hazard during and after construction until a permanent plant cover is established. The slope can also affect the ease of using machinery during construction. The large boulders affect the ease of digging, filling, and compacting during construction. The largest rocks may require larger equipment or blasting. Establishing or maintaining lawns also is affected by the rock fragments. In places topsoil is needed. Septic tank absorption fields should be designed according to the slope and the amount of rock fragments in the soil.

The capability subclass is VIs.

HsF—Highsplint-Cloverlick-Guyandotte complex, 35 to 75 percent slopes, very stony. These deep and very deep, well drained, very steep soils are on the south- and west-facing sides of mountains. The elevations range from about 3,000 feet near the mountain crest to 1,400 feet along the base of the mountain. The higher elevations have more snow and ice during the winter than the lower elevations and may receive more rainfall during the summer. The downward slope of the mountain is nearly linear, except where broken by small cliffs or benches. Only a slight flattening of the slope occurs near the top and bottom of the mountain. Across the mountain the slope is distinctly corrugated. Small streams in the grooves commonly begin near the mountain crest and run almost to the base of the mountain before joining other streams. In most places the streams are about 300 to 600 feet apart. Areas between the streams are characterized by sharp-crested ribs that have fairly smooth slopes. Stones and boulders generally cover 0.1 to 15.0 percent of the surface, but they cover as much as 70 percent of the surface in some ravines and in areas below cliffs. Most areas are nearly rectangular and range from about 60 to 2,500 acres in size.

In a typical area the composition is as follows: Highsplint and similar soils—53 percent; Cloverlick and similar soils—17 percent; Guyandotte and similar soils—10 percent; and contrasting inclusions—20 percent. The soils in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Highsplint soil has a surface layer of dark brown very channery silt loam about 4 inches thick. The upper part of the subsoil is yellowish brown very channery silt loam. The next part is yellowish brown very channery silty clay loam. The lower part to a depth of about 60 inches is yellowish brown very channery loam. In some areas the subsoil contains 20 to 35 percent rock fragments.

Typically, the Cloverlick soil has a surface layer of very dark grayish brown very flaggy loam about 5 inches thick. The subsurface layer is brown very flaggy loam about 6 inches thick. The subsoil to a depth of about 60 inches is dark yellowish brown and yellowish brown very flaggy loam. In some areas the subsoil contains 20 to 35 percent rock fragments. In a few areas the surface layer has a higher content of clay.

Typically, the Guyandotte soil has a surface layer of very dark grayish brown extremely flaggy silt loam about 6 inches thick. The subsurface layer is dark brown extremely flaggy silt loam about 7 inches thick. The subsoil to a depth of about 60 inches is dark yellowish brown and yellowish brown extremely flaggy loam. In some areas the subsoil contains 20 to 35 percent rock fragments. In a few areas the surface layer has a higher content of clay.

These soils are low in natural fertility. The organic matter content is moderate in the Highsplint soil and high in the Cloverlick and Guyandotte soils. The available water capacity is moderate in all three soils. Permeability is moderate or moderately rapid. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 48 inches or more in the Highsplint and Cloverlick soils and 60 inches or more in the Guyandotte soil.

Included in this map unit are small areas of loamy soils that are less than 30 inches deep over bedrock. These soils make up about 10 percent of the unit. Also included, on ledges or cliffs, are areas of rock outcrop, which make up less than 1 percent of the unit.

Most areas are used as woodland. A few areas adjacent to the stream valleys have been cleared and are used as unimproved pasture.

These soils are suited to trees. Productivity is high. In an average stand that is fully stocked, yellow poplar can reach a height of about 100 feet in 50 years. Under similar conditions, northern red oak can reach a height of about 75 feet. Some of the more common tree species in coves and on the lower slopes are sugar maple, yellow poplar, black locust, and northern red oak. In some areas these species are mixed with chestnut oak, red maple, cucumbertree, black cherry, magnolia, birches, and various hickories. Near the base of the mountain, American beech, eastern hemlock, and white oak are common. Many abandoned fields have reverted to nearly pure stands of yellow poplar. Some of the fields have been planted to eastern white pine or other pine species. The most common understory plants are mountain laurel, sourwood, sassafras, azalea, flowering dogwood, American hornbeam, vaccinium, hydrangea, and greenbrier. The herbaceous flora is abundant or luxuriant and includes numerous species.

The hazard of erosion, the equipment limitation, and plant competition are the major concerns in managing woodland. Erosion is a hazard along haul roads and skid trails. This hazard can be reduced by establishing a grade of less than 10 percent along the roads and trails and by limiting the area of surface disturbance to 10 percent or less. Permanent access roads can be protected by water breaks, culverts, and gravel. Because of the slope, crawler tractors or other specialized equipment generally is needed. Logs can be yarded to roads and trails built on the contour. Trees can be planted by hand or by direct seeding methods. Plant competition can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

The potential for woodland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Den trees should not be harvested. Brush piles or other nesting sites are needed.

These soils generally are unsuitable for cultivated crops, pasture, and building site development because of the slope.

The capability subclass is VIIe.

JfD—Jefferson gravelly silt loam, 12 to 20 percent slopes. This very deep, well drained, moderately steep soil is on low hills and along the base of mountains. In most areas the elevations range from about 1,000 to 1,600 feet. Most areas are irregular in shape and range from about 5 to 40 acres in size.

Typically, the surface layer is gravelly silt loam about 9 inches thick. The upper part is dark grayish brown, and the lower part is yellowish brown. The upper part of the subsoil is yellowish brown silt loam. The next part is yellowish brown gravelly loam. The lower part to a depth of about 75 inches is yellowish brown, mottled very gravelly loam.

This soil is low in natural fertility and moderate in organic matter content. The available water capacity is high. Permeability is moderately rapid or moderate. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 60 inches or more.

Included in this map unit are small areas of the Alticrest, Totz, and Varilla soils. These soils are in landscape positions similar to those of the Jefferson soil. They make up about 15 percent of the unit. Also included are a few very small areas of rock outcrop, which make up less than 1 percent of the unit.

Most areas are used as pasture. Many areas that previously were cleared for farming have reverted to woodland. A few areas are used for cultivated crops or gardens.

This soil is poorly suited to cultivated crops, such as corn, unless intensive erosion-control measures are used. Other management concerns are measures that maintain tilth and fertility and reduce the susceptibility to compaction.

This soil is suited to grasses and legumes. It is best suited to tall fescue, white clover, and other forage species that are tolerant of an acid, infertile subsoil. If lime and fertilizer are applied, however, good yields can be obtained from most forage species. The main management concerns are preventing overgrazing and maintaining a good stand. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

This soil is suited to trees. Productivity is moderate. In an average stand that is fully stocked, white oak can reach a height of about 84 feet in 50 years. Plant competition is the major management concern. It can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

The potential for openland wildlife habitat is fair. The habitat can be improved by providing food, cover, water, nesting areas, and den sites. Field borders are good wildlife areas. Trees and shrubs in small areas and along fence rows can break up large open areas and provide food and cover for wildlife. The habitat in areas of native plants can be improved by disking and applying fertilizer. Brush piles or other nesting sites are needed.

This soil is suited to building site development. The slope is the main limitation on sites for dwellings without basements. Leveling is needed to modify the slope. The slope is a limitation on sites for septic tank absorption fields. It also affects the ease of excavating and grading on sites for local roads and streets.

The capability subclass is IVe.

KmD—Kimper silt loam, 5 to 20 percent slopes, very stony. This deep and very deep, well drained, sloping and moderately steep soil is on rounded mountain crests of Black Mountain. The elevations range from about 3,600 to 4,100 feet. The higher elevations have more snow and ice during the winter than the lower elevations and may receive more rainfall during the summer. Slopes are convex and commonly are uniform. Stones and boulders cover about 0.1 to 5.0 percent of the surface. Most areas are nearly oval and range from about 30 to 60 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is yellowish brown channery silt loam about 41 inches thick. Siltstone bedrock is at a depth of about 48 inches. In some areas the soil has a lighter colored surface layer.

This soil is low in natural fertility and high in organic matter content. The available water capacity is high. Permeability is moderate. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 48 inches or more.

Included in this map unit are small areas of Guyandotte and Cloverlick soils and small areas of shallow, loamy soils. These soils are in landscape positions similar to those of the Kimper soil. They make up about 10 percent of the unit. Also included are a few areas of rock outcrop, which make up less than 1 percent of the unit.

Most areas are used as woodland. A few areas that previously were cleared for farming have reverted to woodland.

This soil generally is unsuited to cultivated crops and hay because of the amount of stones on the surface. Small areas can be cleared of surface stones and used for cultivated crops. The main management concerns in these areas are keeping soil erosion to a minimum and maintaining tilth and fertility.

This soil is suited to grasses and legumes, especially in areas that have few stones and boulders. It is best suited to tall fescue, white clover, and other forage species that are tolerant of an acid, infertile subsoil. If lime and fertilizer are applied, however, good yields can be obtained from most forage species.

This soil is suited to trees. Productivity is moderate. In an average stand that is fully stocked, northern red oak can reach a height of about 70 feet in 50 years. Some of the more common species are sugar maple, northern red oak, red maple, black cherry, and birch (fig. 10). Plant competition is the main management concern. It can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by clearing and disking or by managing the existing stand. Table 8 gives additional information about woodland management and productivity.

The potential for woodland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Den trees should not be harvested. Brush piles or other nesting sites are needed.

This soil generally is poorly suited to building site development unless sewer facilities are available. The slope is the main limitation on sites for dwellings without basements. Leveling is needed to modify the slope. The slope and the depth to bedrock are limitations on sites for septic tank absorption fields. The slope also affects the ease of excavating and grading on sites for local roads and streets.

The capability subclass is VIs.

KrF—Kimper-Renox-Sharondale complex, very rocky, 35 to 75 percent slopes. These deep and very deep, very steep soils are on the north-facing slopes of Pine Mountain. The elevations on the upper slopes range from about 1,700 feet in the southern part of Bell County to 2,400 feet in Harlan County. The lower slopes are about 500 to 700 feet lower in elevation than the upper slopes. The shape of the slope across benches generally is uniform. Small concave areas are below prominent gaps along the crest of Pine Mountain, and many of these areas do not have benches. The benches have slopes of 14 to about 45 percent. The shape across the slope and below the benches is nearly uniform, but there are many small irregularities and a few large concave areas. The larger concave areas are in the shallow ravines below the gaps along the crest of the mountain. Stones and boulders generally cover 3 to 15 percent of the surface. In most areas of the Sharondale soil, however, they cover about 15 to 70 percent of the surface. Areas are very long and are about 800 feet wide. They range from about 1,200 to 3,000 acres in size.

In a typical area the composition is as follows: Kimper and similar soils—25 percent; Renox and similar soils—20 percent; Sharondale and similar soils—20 percent; rock outcrop—8 percent; and contrasting inclusions—27 percent. The soils formed in colluvial material derived from the upper slopes and in the underlying material weathered from limestone or shale. The varying kinds of parent material account for most of the variability among the soils in this map unit. The Kimper and Sharondale soils are on benches along the upper slopes and in areas throughout the unit where loamy or stony and loamy colluvium covers the limestone and shale. The Renox soil is on irregular slopes intermingled with or below outcrops of limestone. The rock outcrops are discontinuous ledges and pinnacles of limestone, generally on the very steep slopes below the benches. The soils and rock outcrop in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Kimper soil has a surface layer of dark brown silt loam about 8 inches thick. The subsoil is about 42 inches thick. The upper part is dark yellowish brown silt loam, and the lower part is brown channery silty clay loam. Shale bedrock is at a depth of about 50 inches.

Typically, the Renox soil has a surface layer of very dark grayish brown loam about 6 inches thick. The upper part of the subsoil is brown and dark yellowish brown loam. The next part is strong brown clay loam. The lower part to a depth of about 60 inches is strong brown loam.

Typically, the Sharondale soil has a surface layer of dark brown gravelly silt loam about 11 inches thick. The subsurface layer is dark yellowish brown gravelly silt loam about 3 inches thick. The upper part of the subsoil is yellowish brown very channery silt loam. The lower

Figure 10.—Second-growth stand of black cherry, sweet birch, and yellow birch in an area of Kimper silt loam, 5 to 20 percent slopes, very stony. Yellow birch grows only in the higher mountains.

part to a depth of about 60 inches is yellowish brown very channery loam.

Natural fertility is low in the Kimper soil and medium in the Renox and Sharondale soils. The organic matter content is high in all three soils. The available water capacity is high in the Kimper and Renox soils and moderate in the Sharondale soil. Permeability is moderate in the Kimper and Renox soils and moderately rapid in the Sharondale soil. The number of roots decreases gradually with increasing depth, and there a few roots below a depth of about 18 inches. The depth to bedrock is 48 inches or more in the Kimper soil and 60 inches or more in the Renox and Sharondale soils.

Included in this map unit are pockets of shallow and moderately deep soils intermingled with the Renox soil and areas of rock outcrop. Also included are soils that are deep or very deep and have a very thin surface layer. All of the included soils contain less organic matter than the Kimper, Renox, and Sharondale soils. They make up about 25 to 30 percent of the unit.

Most areas are used as woodland. In a few places the underlying limestone is quarried.

These soils are suited to trees. Productivity is high. In an average stand that is fully stocked, yellow poplar can reach a height of about 107 feet in 50 years. Some of the more common tree species are yellow poplar, sugar maple, basswood, and yellow buckeye. In some areas these species are mixed with northern red oak, red maple, white oak, chestnut oak, cucumbertree, basswood, American beech, various hickories, and numerous species of minor extent. Many abandoned fields have reverted to nearly pure stands of yellow poplar. The most common understory plants are flowering dogwood, American hornbeam, spicebush, hydrangea, and pawpaw. The herbaceous flora is luxuriant and includes numerous species.

The hazard of erosion, the equipment limitation, and plant competition are the major concerns in managing woodland. Erosion is a hazard along haul roads and skid trails. This hazard can be reduced by establishing a grade of less than 10 percent along the roads and trails and by limiting the area of surface disturbance to 10 percent or less. Where crawler tractors are used, as much as 10 percent of the area can be disturbed. Permanent access roads can be protected by water breaks, culverts, and gravel. The bench along the upper slopes of this unit is favored for permanent access roads. Because of the slope, crawler tractors or other specialized equipment generally is needed. Logs can be yarded to roads and trails built on the contour. Trees can be planted by hand or by direct seeding methods. Plant competition can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

The potential for woodland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Den trees should not be harvested. Brush piles or other nesting sites are needed.

These soils generally are unsuitable for cultivated crops, pasture, and building site development because of the slope.

The capability subclass is VIIe.

Ph—Philo fine sandy loam, occasionally flooded. This deep and very deep, moderately well drained, nearly level soil is on flood plains along small streams. Most areas are nearly oval and range from about 6 to 125 acres in size.

Typically, the surface layer is brown fine sandy loam about 9 inches thick. The subsoil is yellowish brown fine sandy loam about 28 inches thick. It is mottled in the lower part. The upper part of the substratum is yellowish brown, mottled extremely gravelly fine sandy loam. The lower part to a depth of about 60 inches is yellowish brown, mottled loamy fine sand. In some areas, the substratum is medium acid or slightly acid or the subsoil has no mottles to a depth of about 30 inches.

This soil is medium in natural fertility and moderate in organic matter content. Permeability is moderate. The available water capacity is moderate. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 48 inches or more. A water table is at a depth of 1.5 to 3.0 feet in late winter and in spring. Most areas are occasionally flooded. The frequency of flooding ranges from about once in 2 years to once in 100 years. The floods are of brief duration.

Included in this map unit are small areas of Bonnie, Pope, and Craigsville soils. These soils are in landscape positions similar to those of the Philo soil. Bonnie soils commonly occur as small seepy or ponded areas. Craigsville soils commonly are on small alluvial fans and foot slopes. Included soils make up about 15 percent of the unit.

Most areas are used for pasture and hay (fig. 11). Some areas are used for corn or garden crops. A few areas that previously were cleared for farming have reverted to woodland.

This soil is well suited to cultivated crops, such as corn, and to the garden crops commonly grown in the survey area. The main management concerns are measures that maintain tilth and fertility and reduce the susceptibility to compaction. In places the period during which the soil is too wet for plowing is longer than that of other soils in the survey area. A surface drainage system and tile drainage can help to remove excess water. Some areas are subject to the scouring and deposition caused by runoff from the adjacent mountain slopes. This runoff can be removed by diversion terraces or by grassed waterways. Tilth is good, and the soil can be worked throughout a wide range of moisture

Figure 11.—An area of Philo fine sandy loam, occasionally flooded, along Little Clear Creek. The soils in this valley are used for pasture, hay, or corn.

conditions. Conservation tillage, cover crops, and applications of lime and fertilizer help to maintain good tilth and fertility.

This soil is well suited to grasses and legumes. The hazard of flooding and measures that maintain fertility are the main management concerns. Measures that prevent overgrazing and maintain a good stand are needed. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

This soil is suited to trees. Productivity is high. In an average stand that is fully stocked, yellow poplar can reach a height of about 102 feet in 50 years. Some of the more common species are yellow poplar and northern red oak. In some areas these species are mixed with American sycamore, green ash, red maple, and elms. Plant competition is the main management concern. It can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by clearing and disking, by applying herbicides, or by managing the existing stand. Excessive rutting or miring can occur when the soil is wet. The use of equipment can be delayed until the soil is dry. Gravel or other suitable material can be added to the main logging roads to reduce the extent of rutting and miring. In places roads should be located on nearby soils that are less prone to rutting and miring. The windthrow hazard is moderate because of the water table. The stands in areas of this soil should be thinned less intensively and more frequently than those in areas where the hazard of windthrow is slight. Table 8 gives additional information about woodland management and productivity.

The potential for openland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Field borders are good wildlife areas. Trees and brush along the streams provide benefits to wildlife as well as erosion control. Brush piles or other nesting sites are needed.

This soil generally is unsuited to building site development unless the guidelines for building on a flood plain are followed.

The capability subclass is IIw.

Po—Pope fine sandy loam, occasionally flooded. This very deep, well drained, nearly level soil is on flood plains along small streams. Slopes range from 0 to 2 percent. Most areas are nearly oval and range from about 6 to 250 acres in size.

Typically, the surface layer is brown fine sandy loam about 4 inches thick. The subsoil is about 41 inches thick. It is yellowish brown. The upper part is fine sandy loam, and the lower part is loamy fine sand that has thin strata of dark yellowish brown fine sandy loam. The upper part of the substratum is dark yellowish brown fine sandy loam. The lower part to a depth of about 62 inches is yellowish brown extremely gravelly sand. In some areas the substratum is medium acid or slightly acid.

This soil is medium in natural fertility and moderate in organic matter content. Permeability is moderately rapid. The available water capacity is moderate. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 60 inches or more. Most areas are occasionally flooded. The frequency of flooding ranges from about once in 2 years to once in 100 years. The floods are of brief duration.

Included in this map unit are small areas of Bonnie, Philo, and Craigsville soils. These soils are in landscape positions similar to those of the Pope soil. Bonnie soils commonly occur as small seepy or ponded areas. Craigsville soils commonly are on small alluvial fans and foot slopes. Also included are small areas of Allegheny and Shelocta soils on stream terraces and foot slopes. Included soils make up about 10 percent of the unit.

Most areas are used for pasture and hay. Some areas are used for corn or garden crops. A few areas that previously were cleared for farming have reverted to woodland.

This soil is well suited to cultivated crops, such as corn and tobacco, and to the garden crops commonly grown in the survey area. The main management concerns are measures that maintain tilth and fertility and reduce the susceptibility to compaction. Some areas are subject to the scouring and deposition caused by runoff from the adjacent mountain slopes. This runoff can be removed by diversion terraces or by grassed waterways. Tilth is good, and the soil can be worked throughout a wide range of moisture conditions. A system of conservation tillage and additions of straw, lime, and fertilizer help to maintain good tilth and fertility.

This soil is well suited to grasses and legumes. The hazard of flooding and measures that maintain fertility are the main management concerns. Measures that prevent overgrazing and maintain a good stand are needed. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

This soil is suited to trees. Productivity is high. In an average stand that is fully stocked, yellow poplar can reach a height of about 96 feet in 50 years. Some of the more common species are American sycamore, blackgum, and American beech. In some areas these species are mixed with green ash, red maple, and elms. Plant competition is the main management concern. It can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by clearing and disking, by applying herbicides, or by managing the existing stand. Table 8 gives additional information about woodland management and productivity.

The potential for openland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Field borders are good wildlife areas. Trees and brush along the streams provide benefits to wildlife as well as erosion control. Brush piles or other nesting sites are needed.

This soil generally is unsuited to building site development unless the guidelines for building on a flood plain are followed.

The capability subclass is IIw.

Sb—Shelbiana loam, occasionally flooded. This very deep, well drained, nearly level soil is on flood plains along major rivers and streams. Slopes range from 0 to 2 percent. Most areas are nearly oval and range from about 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown loam about 15 inches thick. The subsoil to a depth of 70 inches is loam. The upper part is dark brown, the next part is brown, and the lower part is yellowish brown and dark yellowish brown. In some areas, the surface layer is fine sandy loam or the subsoil contains less clay. In other areas the soil is lighter colored below the plow layer.

This soil is medium in natural fertility and high in organic matter content. Permeability is moderate. The available water capacity is high. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 24 inches. The depth to bedrock is 60 inches or more. Most areas are occasionally flooded. The frequency of flooding ranges from about once in 5 years to once in 50 years. The floods are of brief duration.

Included in this map unit are areas of Pope soils and very small areas of Bonnie and Philo soils. Pope soils are in landscape positions similar to those of the Shelbiana soil. Bonnie soils commonly occur as small seepy or ponded areas. Philo soils are in small depressions. Also included are areas of sloping, well drained, moderately coarse textured, alluvial soils adjacent to the stream channels. These soils are stratified throughout and contain more sand and less clay than the Shelbiana soil. Also, they are more frequently flooded. The frequency of flooding generally ranges from about once a year to once in 5 years. Included soils make up about 15 to 20 percent of the unit.

Most areas are used for pasture and hay. Some areas are used for corn or garden crops. Some are used as building sites. A few areas remain wooded. These are mainly the sloping areas adjacent to the river channel.

This soil is well suited to cultivated crops, such as corn and tobacco, and to the garden crops commonly grown in the survey area. The main management concerns are measures that maintain tilth and fertility and reduce the susceptibility to compaction. Some areas are subject to the scouring and deposition caused by runoff from the adjacent mountain slopes. This runoff can be removed by diversion terraces or by grassed waterways. Tilth is good, and the soil can be worked throughout a wide range of moisture conditions. Conservation tillage, cover crops, and applications of lime and fertilizer help to maintain good tilth and fertility.

This soil is well suited to grasses and legumes. The hazard of flooding and measures that maintain fertility are the main management concerns. Measures that prevent overgrazing and maintain a good stand are needed. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

This soil is suited to trees. Productivity is high. In an average stand that is fully stocked, yellow poplar can reach a height of about 110 feet in 50 years. Some of the more common species are green ash and American sycamore. In some areas these species are mixed with red maple and elms. Plant competition is the main management concern. It can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by clearing and disking, by applying herbicides, or by managing the existing stand. Table 8 gives additional information about woodland management and productivity.

The potential for openland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Field borders are good wildlife areas. Trees and brush along the streams provide benefits to wildlife as well as erosion control. Brush piles or other nesting sites are needed.

This soil generally is unsuited to building site development unless the guidelines for building on a flood plain are followed.

The capability subclass is IIw.

SeB—Shelocta gravelly silt loam, 2 to 6 percent slopes. This deep and very deep, well drained, gently sloping soil is on alluvial fans and foot slopes. Areas of the soil commonly lie at the base of drainageways that dissect the mountain sides. In most areas the elevations range from about 1,000 to 1,600 feet. The downhill slope commonly is slightly concave. The shape across the slope is convex, except where broken by a stream channel. The natural drainageway commonly splits into two or more channels along the upper slopes in this unit. Most areas are nearly oval or pear shaped and range from about 6 to 20 acres in size.

Typically, the surface layer is brown gravelly silt loam about 7 inches thick. The subsoil is about 40 inches of strong brown silt loam and yellowish brown loam. The substratum to a depth of about 60 inches is yellowish brown loam.

This soil is low in natural fertility and moderate in organic matter content. The available water capacity is high. Permeability is moderate. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 48 inches or more.

Included in this map unit are Philo, Pope, and Craigsville soils in narrow areas adjacent to streams. These soils are occasionally flooded. Also included are small areas of Highsplint soils and areas of short, very steep slopes adjacent to stream meanders. Highsplint soils have stones and boulders on the surface. They are commonly on the upper part of fans. Included soils make up about 15 percent of the unit.

Most areas are used as pasture. Many areas that previously were cleared for farming have reverted to woodland. A few areas are used for cultivated crops or gardens.

This soil is well suited to cultivated crops, such as corn and tobacco, and to the garden crops commonly grown in the survey area. The main management concerns are keeping erosion to a minimum and maintaining tilth and fertility. In some areas runoff from the adjacent mountain slopes can cause gully erosion or can deposit gravel. This runoff can be removed by diversion terraces or by grassed waterways. Terraces, conservation tillage, and a crop rotation that includes grasses and legumes help to control erosion. No limitations affect terracing. A crop rotation in which grasses and legumes are grown in about 1 out of every 4 years is needed to control erosion in most areas. A system of conservation tillage can prevent excessive erosion in many areas where crops are grown year after year. Conservation tillage and cover crops help to maintain good tilth and fertility.

This soil is suited to grasses and legumes. It is best suited to tall fescue, lespedeza, and other forage species that are tolerant of an acid, infertile subsoil. If lime and fertilizer are applied, however, good yields can be obtained from most forage species. The main management concerns are preventing overgrazing and maintaining a good stand. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

This soil is suited to trees. Productivity is moderate. In an average stand that is fully stocked, white oak can reach a height of about 78 feet in 50 years. Plant competition is the major management concern. It can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

This soil is suited to building site development. No limitations affect dwellings without basements. In places the depth to bedrock is a limitation on sites for septic tank absorption fields.

The capability subclass is IIe.

SeC—Shelocta gravelly silt loam, 6 to 12 percent slopes. This deep and very deep, well drained, sloping soil is on alluvial fans and foot slopes. Areas of the soil commonly lie at the base of drainageways that dissect the mountain sides. In most areas the elevations range from about 1,000 to 1,600 feet. The downhill slope commonly is slightly concave. The shape across the slope is convex, except where broken by a stream channel. The natural drainageway commonly splits into two or more channels along the upper slopes in this unit. Most areas are nearly oval or pear shaped and range from about 6 to 20 acres in size.

Typically, the surface layer is yellowish brown gravelly silt loam about 6 inches thick. The subsoil is about 36 inches of yellowish brown silt loam and clay loam. The substratum to a depth of about 60 inches is strong brown silty clay loam.

This soil is low in natural fertility and moderate in organic matter content. The available water capacity is high. Permeability is moderate. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 48 inches or more.

Included in this map unit are Philo, Pope, and Craigsville soils in narrow areas adjacent to streams. These soils are occasionally flooded. Also included are small areas of Highsplint soils and areas of short, very steep slopes adjacent to stream meanders. Highsplint soils have stones and boulders on the surface. They commonly are on the upper part of fans. Included soils make up about 15 percent of the unit.

Most areas are used as pasture. Many areas that previously were cleared for farming have reverted to woodland. A few areas are used for cultivated crops or gardens.

This soil is suited to cultivated crops, such as corn and tobacco, and to the garden crops commonly grown in the survey area. The main management concerns are keeping erosion to a minimum and maintaining tilth and fertility. In some areas runoff from the adjacent mountain slopes can cause gully erosion or can deposit gravel. This runoff can be removed by diversion terraces or by grassed waterways. Terraces, conservation tillage, and a crop rotation that includes grasses and legumes help to control erosion. Except for the slope, no limitations affect terracing. As the slope increases, deeper cuts and fills are needed to construct the terraces. A crop rotation in which grasses and legumes are grown in about 2 out of every 4 years is needed to control erosion in most areas. A system of conservation tillage can increase the number of years when cultivated crops can be included in the rotation. Conservation tillage and cover crops help to maintain good tilth and fertility.

This soil is suited to grasses and legumes. It is best suited to tall fescue, lespedeza, and other forage species that are tolerant of an acid, infertile subsoil. If lime and fertilizer are applied, however, good yields can be obtained from most forage species. The main management concerns are preventing overgrazing and maintaining a good stand. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

This soil is suited to trees. Productivity is moderate. In an average stand that is fully stocked, white oak can reach a height of about 78 feet in 50 years. Plant competition is the major management concern. It can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

This soil is suited to building site development. The slope is a limitation on sites for dwellings without basements. Leveling is needed to modify the slope. In places the depth to bedrock is a limitation on sites for septic tank absorption fields.

The capability subclass is IIIe.

SgE—Shelocta-Gilpin silt loams, 20 to 35 percent slopes. These very deep to moderately deep, well drained, steep soils are on low hills and mountains. In most areas the elevations range from about 1,000 to 1,600 feet, but some areas on rounded mountain summits are at an elevation of about 2,000 feet. Most areas are irregular in shape and range from about 10 to 200 acres in size.

In a typical area the composition is as follows: Shelocta and similar soils—50 percent; Gilpin and similar soils—35 percent; and contrasting inclusions—15 percent. Most areas of the Shelocta soil are on side slopes. Commonly, the Gilpin soil is on the small summit slopes. The soils in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Shelocta soil has a surface layer of silt loam about 6 inches thick. The upper part of this layer is brown, and the lower part is yellowish brown. The subsoil is about 52 inches of yellowish brown silty clay loam, channery silt loam, and channery loam. Siltstone bedrock is at a depth of about 58 inches.

Typically, the Gilpin soil has a surface layer of silt loam about 6 inches thick. The upper part of this layer is very dark grayish brown, and the lower part is yellowish brown. The subsoil is brownish yellow silty clay loam about 20 inches thick. Siltstone bedrock is at a depth of about 26 inches.

These soils are low in natural fertility and moderate in organic matter content. The available water capacity is moderate in the Gilpin soil and high in the Shelocta soil. Permeability is moderate in both soils. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock ranges from 20 to 40 inches in the Gilpin soil and is 48 inches or more in the Shelocta soil.

Included in this map unit are small areas of Sequoia soils and shallow, loamy soils. These soils make up about 15 percent of the unit. Also included are a few very small areas of rock outcrop, which make up less than 1 percent of the unit.

Most areas are used as pasture. Many areas that previously were cleared for farming have reverted to woodland. A few areas are used for cultivated crops or gardens.

These soils are suited to grasses and legumes. They are best suited to tall fescue, lespedeza, and other forage species that are tolerant of an acid, infertile subsoil. If lime and fertilizer are applied, however, good yields can be obtained from most forage species. The main management concerns are preventing overgrazing and maintaining a good stand. Overgrazing causes compaction, deterioration of the stand, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition.

These soils are suited to trees. Productivity is moderate. In an average stand that is fully stocked, black oak on the Shelocta soil can reach a height of about 70 feet in 50 years. The hazard of erosion, the equipment limitation, and plant competition are the major concerns in managing woodland. Erosion is a hazard along haul roads and skid trails. This hazard can be reduced by establishing a grade of less than 10 percent along the roads and trails and by limiting the area of surface disturbance to 10 percent or less. Where crawler tractors are used as much as 10 percent of the area can be disturbed. Permanent access roads can be protected by water breaks, culverts, and gravel. Because of the slope, crawler tractors or other specialized equipment generally is needed. Logs can be yarded to roads and trails built on the contour. Trees can be planted by hand or by direct seeding methods. Plant competition can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

The potential for openland and woodland wildlife habitat is fair or good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Field borders are good wildlife areas. Trees and shrubs in small areas and along fence rows can break up large open areas and provide food and cover for wildlife. Den trees should not be harvested. Brush piles or other nesting sites are needed.

These soils generally are unsuitable for cultivated crops and building site development because of the slope.

The capability subclass is VIe.

ShF—Shelocta-Highsplint complex, 35 to 75 percent slopes, very stony. These deep and very deep, well drained, very steep soils are on the warm slopes of mountain sides. The elevations range from about 2,000 feet near the mountain crest to 1,000 feet along the base of the mountain. The downward slope of the mountain is nearly linear, except where broken by small cliffs or benches. Only a slight flattening of the slope occurs near the top and bottom of the mountain. Across the mountain the slope is distinctly corrugated. Small streams in the grooves commonly begin near the mountain crest and run almost to the base of the mountain before joining other streams. In most places these streams are about 300 to 600 feet apart. Areas between the streams are characterized by sharp-crested ribs that have fairly smooth slopes. Stones and boulders generally cover about 0.1 to 15.0 percent of the surface. In most areas of the Highsplint soil, however, they cover 15 to 70 percent of the surface. Most areas are nearly rectangular and range from about 30 to 500 acres in size.

In a typical area the composition is as follows: Shelocta and similar soils—60 percent; Highsplint and similar soils—20 percent; and contrasting inclusions—20 percent. The Shelocta soil is throughout this map unit. The Highsplint soil is in the ravines, on the lower side slopes, and in many other colluvial areas. The soils in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Shelocta soil has a surface layer of dark brown gravelly loam about 3 inches thick. The upper part of the subsoil is yellowish brown gravelly silt loam. The next part is strong brown loam. The lower part to a depth of about 60 inches is strong brown channery loam. In some areas the subsoil is loam throughout. In other areas bedrock is at a depth of 40 to 48 inches.

Typically, the Highsplint soil has a surface layer of very dark grayish brown very channery loam about 2 inches thick. The subsoil to a depth of about 60 inches is yellowish brown gravelly loam and very gravelly loam. In some areas the soil has a dark surface layer about 5 to 9 inches thick.

These soils are low in natural fertility and moderate in organic matter content. The available water capacity is high in the Shelocta soil and moderate in the Highsplint soil. Permeability is moderate in the Shelocta soil and moderate or moderately rapid in the Highsplint soil. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 48 inches or more.

Included in this map unit are small areas of Kimper, Cutshin, and Guyandotte soils and shallow or moderately deep, loamy soils. These soils make up about 18 percent of the unit. Kimper, Cutshin, and Guyandotte soils are in small areas on cool slopes. The shallow or moderately deep, loamy soils are on some of the convex ribs. Also included, on ledges or cliffs, are areas of rock outcrop, which make up about 2 percent of the unit.

Most areas are used as woodland. A few areas adjacent to the stream valleys have been cleared and are used as unimproved pasture.

These soils are suited to trees. Productivity is moderate. In an average stand that is fully stocked, white oak on the Shelocta soil can reach a height of about 65 feet in 50 years. Some of the more common tree species in coves and on the lower slopes are white oak, American beech, and yellow poplar. In some areas these species are mixed with chestnut oak, scarlet oak, red maple, blackgum, northern red oak, sugar maple, pitch pine, various hickories, and numerous species of minor extent. Many abandoned fields have reverted to nearly pure stands of yellow poplar. Some of the fields have been planted to eastern white pine or other pine species. The most common understory plants are flowering dogwood, American hornbeam, sassafras, eastern redbud, grape, mountain laurel, and greenbrier. The herbaceous flora is sparse, but numerous species are evident.

The hazard of erosion, the equipment limitation, seedling mortality, and plant competition are the major concerns in managing woodland. Erosion is a hazard along haul roads and skid trails. This hazard can be reduced by establishing a grade of less than 10 percent along the roads and trails and by limiting the area of surface disturbance to 10 percent or less. Permanent access roads can be protected by water breaks, culverts, and gravel. Because of the slope, crawler tractors or other specialized equipment generally is needed. Logs can be yarded to roads and trails built on the contour. Trees can be planted by hand or by direct seeding methods. Seedling mortality may be greater than usual because of south and west exposures. Plant competition can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

The potential for woodland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Den trees should not be harvested. Brush piles or other nesting sites are needed.

These soils generally are unsuitable for cultivated crops, pasture, and building site development because of the slope.

The capability subclass is VIIe.

SkF—Shelocta-Kimper-Cloverlick complex, 35 to 75 percent slopes, very stony. These deep and very deep, well drained, very steep soils are on the cool slopes of mountain sides. The elevations range from about 2,000 feet near the mountain crest to 1,000 feet along the base of the mountain. The downward slope of the mountain is nearly linear, except where broken by small cliffs or benches. Only a slight flattening of the slope occurs near the top and bottom of the mountain. Across the mountain the slope is distinctly corrugated. Small streams in the grooves commonly begin near the mountain crest and run to near the base of the mountain before joining other streams. In most places the streams are about 300 to 600 feet apart. Areas between the streams are characterized by sharp-crested ribs that have fairly smooth slopes. Stones and boulders generally cover about 0.1 to 15.0 percent of the surface. In most areas of the Cloverlick soil on the lower slopes, however, they cover 15 to 70 percent of the surface. Most areas are nearly rectangular and range from about 30 to 500 acres in size.

In a typical area the composition is as follows: Shelocta and similar soils—30 percent; Kimper and similar soils—30 percent; Cloverlick and similar soils—20 percent; and contrasting inclusions—20 percent. The Shelocta soil is throughout this map unit. The Kimper soil is in coves and on side slopes. The Cloverlick soil is in the ravines, on the lower side slopes, and in many other colluvial areas. The soils in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Shelocta soil has a surface layer of channery silt loam about 8 inches thick. The upper part of this layer is dark grayish brown, and the lower part is dark yellowish brown. The subsoil to a depth of about 60 inches is yellowish brown channery clay loam and silty clay loam. In some areas the subsoil is loam throughout. In other areas bedrock is at a depth of 40 to 48 inches.

Typically, the Kimper soil has a surface layer of dark brown silt loam about 9 inches thick. The subsurface layer is brown silt loam about 8 inches thick. The subsoil to a depth of about 60 inches is yellowish brown channery loam. In some areas the soil has a dark surface layer that is 10 to 13 inches thick. In a few areas the content of clay is 35 to 45 percent in the upper part of the profile. In places bedrock is at a depth of 40 to 48 inches.

Typically, the Cloverlick soil has a surface layer of very dark grayish brown and dark brown very gravelly loam about 7 inches thick. The upper part of the subsoil is brown very cobbly loam. The lower part to a depth of about 60 inches is yellowish brown very cobbly loam. In some areas the soil has a lighter colored surface layer. In a few areas it has a dark surface layer that is 10 to 13 inches thick.

These soils are low in natural fertility. The organic matter content is moderate in the Shelocta soil and high in the Kimper and Cloverlick soils. The available water capacity is high in the Shelocta and Kimper soils and moderate in the Cloverlick soil. Permeability is moderate in all three soils. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 48 inches or more.

Included in this map unit are areas of Cutshin, Gilpin, Guyandotte, Helechawa, Sequoia, and Varilla soils and shallow or moderately deep, loamy soils. These soils make up about 18 percent of the unit. The shallow or moderately deep, loamy soils are dominantly on the convex ribs but occur throughout this map unit. Cutshin and Guyandotte soils are most common on concave slopes, such as in coves and the innermost part of the small benches. Helechawa and Varilla soils are in scattered areas where sandstone is the dominant soil-forming material. Also included, on ledges or cliffs, are areas of rock outcrop, which make up about 2 percent of the unit.

Most areas are used as woodland. A few areas adjacent to the stream valleys have been cleared and are used as unimproved pasture.

These soils are suited to trees. Productivity is high. In an average stand that is fully stocked, yellow poplar on the Shelocta soil can reach a height of about 102 feet in 50 years. On the Kimper soil, a similar stand can reach a height of 107 feet. Some of the more common tree species in coves and on the lower slopes are yellow poplar, sugar maple, American beech, and eastern hemlock. In some areas these species are mixed with northern red oak, red maple, white oak, chestnut oak, cucumbertree, basswood, yellow buckeye, various hickories, and numerous species of minor extent. Many abandoned fields have reverted to nearly pure stands of yellow poplar. Some of the fields have been planted to eastern white pine or other pine species. The most common understory plants are flowering dogwood, American hornbeam, vaccinium, hydrangea, and greenbrier. The herbaceous flora is luxuriant and includes numerous species.

The hazard of erosion, the equipment limitation, and plant competition are the major concerns in managing woodland. Erosion is a hazard along haul roads and skid trails. This hazard can be reduced by establishing a grade of less than 10 percent along the roads and trails and by limiting the area of surface disturbance to 10 percent or less. Permanent access roads can be protected by water breaks, culverts, and gravel. Because of the slope, crawler tractors or other specialized equipment generally is needed. Logs can be yarded to roads and trails built on the contour. Trees can be planted by hand or by direct seeding methods. Plant competition can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

The potential for woodland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Den trees should not be harvested. Brush piles or other nesting sites are needed.

These soils generally are unsuitable for cultivated crops, pasture, and building site development because of the slope.

The capability subclass is VIIe.

SmF—Shelocta-Kimper-Cutshin complex, 20 to 55 percent slopes, very stony. These deep and very deep, well drained, steep and very steep soils are on ridgetops, mountain crests, and the upper side slopes in the mountains. In most areas the elevations range from about 2,500 to 3,500 feet and are about 1,000 to 2,000 feet above the valley floor. The higher elevations have more snow and ice during the winter than the lower elevations and may receive more rainfall during the summer. Knolls and gaps are along the crest of the ridges. Steep-sided ravines near the head of drainageways incise the ridges. In places all that remains of the ridge is a sharp-crested ridgeline. Stones and boulders cover about 0.1 to 15.0 percent of the surface. Most areas are long and narrow and range from 40 to 1,600 acres in size.

In a typical area the composition is as follows: Shelocta and similar soils—35 percent; Kimper and similar soils—25 percent; Cutshin and similar soils—15 percent; and contrasting inclusions—25 percent. The Shelocta soil is throughout this map unit. Most areas of the Cutshin and Kimper soils are on north- and east-facing slopes and at the head of drainageways. In places, they are on the summits. The soils in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Typically, the Shelocta soil has a surface layer of silt loam about 8 inches thick. The upper part of this layer is dark grayish brown, and the lower part is yellowish brown. The subsoil is yellowish brown channery silt loam about 47 inches thick. Siltstone bedrock is at a depth of about 55 inches. In some areas the subsoil contains 35 to 50 percent rock fragments. In a few areas the surface layer has a higher content of clay.

Typically, the Kimper soil has a surface layer of gravelly silt loam about 7 inches thick. The upper part of this layer is very dark grayish brown, and the lower part is dark yellowish brown. The subsoil is about 41 inches thick. It is yellowish brown. It is gravelly silty clay loam in the upper part and very gravelly silt loam in the lower part. The substratum is yellowish brown and strong brown channery silt loam about 14 inches thick. Shale bedrock is at a depth of about 62 inches. In some areas the subsoil contains 35 to 50 percent rock fragments. In a few areas the surface layer has a higher content of clay.

Typically, the Cutshin soil has a surface layer of very dark gray silt loam about 9 inches thick. The subsurface layer is dark brown silt loam about 8 inches thick. The upper part of the subsoil is yellowish brown silt loam. The next part is yellowish brown gravelly loam. The lower part to a depth of about 60 inches is yellowish brown very gravelly loam. In some areas the subsoil contains 35 to 50 percent rock fragments. In a few areas the surface layer has a higher content of clay.

These soils are low in natural fertility. The organic matter content is moderate in the Shelocta soil and high in the Kimper and Cutshin soils. The available water capacity is high. Permeability is moderate in all three soils. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 40 inches or more in the Cutshin soil and 48 inches or more in the Kimper and Shelocta soils.

Included in this map unit are small areas of shallow or moderately deep, loamy soils. These soils are dominantly on convex spurs but occur throughout the unit. They make up about 18 percent of the unit. Also included, on ledges or cliffs, are areas of rock outcrop, which make up about 2 percent of the unit.

Most areas are used as woodland. These soils are suited to trees. Productivity is moderate. In an average stand that is fully stocked, northern red oak on the Shelocta soil can reach a height of about 65 feet in 50 years. A similar stand on the Kimper and Cutshin soils can reach a height of 70 to 75 feet. Some of the more common tree species are northern red oak, chestnut oak, sugar maple, red maple, and black cherry. In some areas these species are mixed with birches, black locust, cucumbertree, American basswood, yellow buckeye, various hickories, and numerous species of minor extent. The most common understory plants are mountain laurel, sassafras, azalea, buffalo nut, American hornbeam, striped maple, vaccinium, hydrangea, and greenbrier and, in places, American chestnut. The herbaceous flora is luxuriant to sparse and includes numerous species.

The hazard of erosion, the equipment limitation, and plant competition are the major concerns in managing woodland. Erosion is a hazard along haul roads and skid trails. This hazard can be reduced by establishing a grade of less than 10 percent along the roads and trails and by limiting the area of surface disturbance to 10 percent or less. Permanent access roads can be protected by water breaks, culverts, and gravel. Because of the slope, crawler tractors or other specialized equipment generally is needed. Logs can be yarded to roads and trails built on the contour. Trees can be planted by hand or by direct seeding methods. Plant competition can be a problem because site conditions favor the growth of competing plants. A new forest crop can be established by managing the existing stand and by applying herbicides or cutting. Table 8 gives additional information about woodland management and productivity.

The potential for woodland wildlife habitat is good. The habitat can be maintained or improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Den trees should not be harvested. Brush piles or other nesting sites are needed.

These soils generally are unsuitable for cultivated crops, pasture, and building site development because of the slope.

The capability subclass is VIIe.

Ud—Udorthents-Urban land complex, occasionally flooded. This map unit is on flood plains. The Udorthents are very deep, nearly level, well drained soils that formed in gravelly, loamy fill material and in the underlying natural soil. The fill material is mine spoil, coal refuse, or other earthy material. Urban land is covered by streets, parking lots, buildings, and other structures. The natural drainage pattern commonly has been altered by a system of ditches and storm drains. Most areas are nearly rectangular and range from about 6 to 340 acres in size.

In a typical area the composition is as follows: Udorthents—55 percent; Urban land—20 percent; and contrasting inclusions—25 percent. The soils and Urban land in this unit occur as areas are so closely intermingled that they could not be separated at the scale selected for mapping.

Natural fertility and the organic matter content are low in the Udorthents. Because of the nature of the material, permeability varies widely in the upper part of the profile. It is moderately rapid in the lower part. The available water capacity is moderate. The thickness of the fill material generally is 20 to 40 inches. Flooding generally occurs once every 10 to 100 years and is of very brief duration.

Included in this map unit are areas of Pope and Shelbiana soils. These areas are less than 5 acres in size. Also included are areas of gravelly or cobbly soils on small alluvial fans, some areas that are filled to a level above the present level of flooding, and some protected areas. Included soils make up about 25 percent of the unit.

Most areas are used for urban development. This unit is poorly suited to urban uses because of the hazard of flooding. Better suited sites generally are not available in the survey area. Areas where the guidelines for building on a flood plain are followed can be developed for urban uses. The flooding is the only limitation on sites for dwellings without basements and for small commercial buildings. Small community waste treatment plants can be used. Where local roads and streets are constructed, low strength in the Udorthents limits the traffic-supporting capacity. Gravel or other suitable base material is needed. The sides or cutbanks of shallow excavations can cave in because of a low content of clay. As a result, they should be shaped or shored.

The soil conditions generally favor lawns, other landscaping plants, and garden crops. Some areas have too many stones. The larger stones can be removed, or suitable topsoil can be added. The main management concern in areas used for garden crops is maintaining tilth and fertility. The soils best suited to these crops are the included soils, such as Shelbiana soils. Adding organic material, such as straw, leaves, and compost, helps to maintain tilth. Reaction ranges from strongly acid to neutral, depending on the kind of fill material. The kinds and amounts of lime and fertilizer to be applied should be based on the results of soil tests and the needs of the crop.

Wildlife habitat in urban areas can be improved by providing food, cover, nesting areas, and den sites. Many of the trees and shrubs provide food. Wooded areas can be maintained on steep slopes and along streams. The borders around parks, cemeteries, and utility rights-of-way can provide habitat diversity. Certain grass and wildflower species can provide an alternative ground cover to manicured lawns and are beneficial to wildlife. Nesting and den sites are needed.

No capability subclass is assigned.

UrC—Udorthents-Urban land complex, 3 to 15 percent slopes. This map unit is on uplands. The Udorthents are deep and very deep, gently sloping or sloping, well drained soils that formed in channery, loamy material. In most areas the channery, loamy material consists of mixed topsoil, subsoil, and the substratum where the natural soil was graded and smoothed during urban development. Urban land is covered by roads, parking lots, buildings, and other structures. In places the natural drainage pattern has been altered by a system of ditches and storm drains. Areas are nearly rectangular and range from about 6 to 100 acres in size.

In a typical area the composition is as follows: Udorthents—55 percent; Urban land—20 percent; and contrasting inclusions—25 percent. The soils and Urban land in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Natural fertility and the organic matter content are low in the Udorthents. Permeability varies widely because of the nature of the material. The available water capacity is moderate or low. In most areas the thickness of the mixed material is 20 to 40 inches. In some areas 10 or more inches of the natural soil has been removed. The depth to bedrock ranges from 40 to more than 72 inches.

Included in this map unit are areas of Gilpin and Shelocta soils and areas of shallow, loamy soils. Also included are bedrock escarpments along highway road cuts. Included areas make up about 25 percent of the unit.

Most areas are used for urban development. This unit is suited to urban uses. The slope in most areas and the depth to bedrock in some areas are limitations affecting shallow excavations, dwellings with or without basements, local roads and streets, and lawns. In some areas where the slope is less than about 8 percent, the main limitation is the depth to bedrock. Roads, streets, dwellings, and small commercial buildings should be designed so that they conform to the natural slope of the land. In places land shaping is needed. The slope can affect the ease of operating machinery during construction. Erosion is a hazard during and after construction. A permanent plant cover is needed. The depth to bedrock can affect the ease of digging, filling, and shaping during construction. In places heavy equipment or blasting is needed. The areas that do not have bedrock within a depth of 72 inches are the best sites for septic tank absorption fields. In places low strength is a limitation on sites for local roads and streets. Gravel or other suitable base material is needed to improve the traffic-supporting capacity.

The soil conditions generally favor lawns, other landscaping plants, and garden crops. The main limitations are a large number of small stones, excessive compaction, and a limited rooting depth. The species that grow best are those that are tolerant of an acid, infertile soil that commonly is droughty. If lime, fertilizer, and water are applied, most of the climatically adapted lawn and landscaping plants can be grown. In places organic material, such as bark and mulch, is needed. In some areas an excessive number of stones, a limited depth, or short, steep slopes can affect the ease of establishing and maintaining lawns. In these areas additions of suitable topsoil or establishment of a ground cover is needed.

Wildlife habitat in urban areas can be improved by providing food, cover, nesting areas, and den sites. Many of the trees and shrubs provide food. Wooded areas can be maintained on steep slopes and along streams. The borders around parks, cemeteries, and utility rights-of-way can provide habitat diversity. Certain grass and wildflower species can provide an alternative ground cover to manicured lawns and are beneficial to wildlife. Nesting and den sites are needed.

No capability subclass is assigned.

UrE—Udorthents-Urban land complex, 15 to 35 percent slopes. This map unit is on uplands. The Udorthents are deep and very deep, moderately steep or steep, well drained soils that formed in channery, loamy material. In most areas the channery, loamy material consists of mixed topsoil, subsoil, and the substratum where the natural soil was graded and smoothed during urban development. Urban land is covered by roads, parking lots, buildings, and other structures. In places the natural drainage pattern has been altered by a system of ditches and storm drains. Areas are nearly rectangular and range from about 6 to 150 acres in size.

In a typical area the composition is as follows: Udorthents—55 percent; Urban land—20 percent; and contrasting inclusions—25 percent. The soils and Urban land in this unit occur as areas so closely intermingled that they could not be separated at the scale selected for mapping.

Natural fertility and the organic matter content are low in the Udorthents. Permeability varies widely because of the nature of the material. The available water capacity is moderate or low. In most areas either the depth of the mixed material is 20 to 40 inches or about 10 inches or more of the natural soil was removed. The depth to bedrock ranges from 40 to more than 72 inches.

Included in this map unit are areas of Gilpin and Shelocta soils and small areas of shallow, loamy soils. Also included are small benched areas of bedrock escarpments and rubble along highway road cuts. Included areas make up about 25 percent of the unit.

Most areas are used for urban development. This unit is poorly suited to urban uses. Better suited sites generally are not available in the survey area. The slope in most areas and the depth to bedrock in some areas are limitations affecting shallow excavations, dwellings with or without basements, local roads and streets, and lawns. Roads, streets, dwellings, and small commercial buildings should be designed so that they conform to the natural slope of the land. In most areas land shaping is needed. The slope can affect the ease of operating machinery during construction. Erosion is a hazard during and after construction. A permanent plant cover is needed. The depth to bedrock can affect the ease of digging, filling, and shaping during construction. In places heavy equipment or blasting is needed. The areas that do not have bedrock within a depth of 72 inches are the best sites for septic tank absorption fields. In places low strength is a limitation on sites for local roads and streets. Gravel or other suitable base material is needed to improve the traffic-supporting capacity.

The soil conditions generally favor lawns, other landscaping plants, and garden crops. The main limitations are the slope, a large number of small stones, excessive compaction, and a limited rooting depth. The species that grow best are those that are tolerant of an acid, infertile soil that commonly is droughty. If lime, fertilizer, and water are applied, most of the climatically adapted lawn and landscaping plants can be grown. In places organic material, such as bark and mulch, is needed. In some areas an excessive number of stones, a limited depth, or short, steep slopes can affect the ease of establishing and maintaining lawns. In these areas additions of suitable topsoil or establishment of a ground cover is needed.

Wildlife habitat in urban areas can be improved by providing food, cover, nesting areas, and den sites. Many of the trees and shrubs provide food. Wooded areas can be maintained on steep slopes and along streams. The borders around parks, cemeteries, and utility rights-of-way can provide habitat diversity. Certain grass and wildflower species can provide an alternative ground cover to manicured lawns and are beneficial to wildlife. Nesting and den sites are needed.

No capability subclass is assigned.

VrD—Varilla very stony loam, 5 to 20 percent slopes, extremely bouldery. This deep and very deep, somewhat excessively drained, gently sloping and moderately steep soil is on the lower slopes of Cumberland Mountain. The elevations range from about 1,500 to 1,800 feet. Slopes are irregular. Stones and boulders cover about 5 to 40 percent of the surface. Most boulders are as much as 6 feet in diameter, but some range as much as 30 feet. Most areas are nearly oval and range from about 15 to 300 acres in size.

Typically, the surface layer is very stony loam about 5 inches thick. It is very dark grayish brown in the upper part and yellowish brown in the lower part. The upper part of the subsoil is yellowish brown very stony loam. The lower part to a depth of about 60 inches is strong brown extremely gravelly sandy loam.

This soil is low in natural fertility and low in organic matter content. The available water capacity is low. Permeability is moderately rapid. The number of roots decreases gradually with increasing depth, and there are few roots below a depth of about 18 inches. The depth to bedrock is 48 inches or more.

Included in this map unit are small areas of Helechawa, Jefferson, and Shelocta soils. These soils are in landscape positions similar to those of the Varilla soil. They make up about 10 percent of the unit.

Most areas are used as woodland. A few areas have been cleared and are used for pasture, cultivated crops, or building site development.

This soil generally is unsuited to cultivated crops and hay because of the amount of rocks on the surface. Small areas can be cleared of rocks and used for cultivated crops. The main management concerns in these areas are keeping erosion to a minimum and maintaining tilth and fertility.

In most areas this soil is poorly suited to grasses and legumes for pasture because of the amount of rocks on the surface. Areas that have fewer stones and boulders are better suited than other areas.

This soil is suited to trees. Productivity is moderate. In an average stand that is fully stocked, scarlet oak can reach a height of about 70 feet in 50 years. The equipment limitation and seedling mortality are management concerns. Harvesting equipment capable of operating on rough, bouldery terrain should be used. Roads and trails should be built around the larger rocks. Trees should be planted by hand or by direct seeding methods. Table 8 gives additional information about woodland management and productivity.

The potential for woodland wildlife habitat is fair. The habitat can be improved by providing food, cover, nesting areas, and den sites. Brushy thickets can be established by clearing small areas in large tracts of mature woodland. Food plots or areas of green browse can be established along logging roads and trails. The habitat in areas of native plants can be improved by disking and applying fertilizer. Den trees should not be harvested. Brush piles or other nesting sites are needed.

This soil is poorly suited to building site development. The main limitations are the slope and large stones. Roads, streets, and houses should be designed according to the slope. In places land shaping can modify the slope. Because of the slope, erosion is a hazard during and after construction until a permanent plant cover is established. The slope can also affect the ease of using machinery during construction. The large rocks affect digging, filling, and compacting during construction. The largest rocks may require larger equipment or blasting. Establishing or maintaining lawns also is affected by the rocks. In places topsoil is needed. Septic tank absorption fields should be designed according to the slope and the amount of rock in the soil.

The capability subclass is VIs.

Prime Farmland

In this section, prime farmland is defined and the soils in Bell and Harlan Counties that are considered prime farmland are listed.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to food, feed, forage, fiber, and oilseed crops. Such soils have properties that favor the economic production of sustained high yields of crops. The soils need only to be treated and managed by acceptable farming methods. The moisture supply must be adequate, and the growing season must be sufficiently long. Prime farmland soils produce the highest yields with minimal expenditure of energy and economic resources. Farming these soils results in the least damage to the environment.

Prime farmland soils may presently be used as cropland, pasture, or woodland or for other purposes. They are used for food or fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water-control structures. Public land is land not available for farming in national forests, national parks, military reservations, and state parks.

Prime farmland soils usually receive an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not frequently flooded during the growing season. The slope ranges mainly from 0 to 8 percent.

The soils that meet the requirements for prime farmland make up about 7,200 acres in Bell County and 4,700 acres in Harlan County. These soils are in areas along the Cumberland River and its main tributaries. The main crops grown on the prime farmland soils are corn, tobacco, hay, or pasture plants. In places the prime farmland has been converted to urban and industrial uses.

The following map units are considered prime farmland in Bell and Harlan Counties. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 5. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

Some soils that have a high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. If applicable, the need for these measures is indicated in parentheses after the map unit name in the following list. Onsite evaluation is necessary to determine if the limitation has been overcome by corrective measures.

The soils identified as prime farmland in Bell and Harlan Counties are:

AgB	Allegheny loam, 2 to 8 percent slopes
Bo	Bonnie silt loam, occasionally flooded (where drained)
Ph	Philo fine sandy loam, occasionally flooded
Po	Pope fine sandy loam, occasionally flooded
Sb	Shelbiana loam, occasionally flooded
SeB	Shelocta gravelly silt loam, 2 to 6 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern that is in harmony with nature.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Henry Amos, agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Kentucky Cooperative Extension Service.

Less than 3 percent of the survey area is used for crops and pasture. Of this total, about one-third is used for crops, mainly corn, hay, and some tobacco, Irish potatoes, and wheat. Other crops are vegetables, small fruits, tree fruits, and nursery plants. A small acreage is used for tomatoes, strawberries, blackberries, melons, sweet corn, peppers, cabbage, or other vegetables and small fruits. Apples and peaches are the most important tree fruits grown in the survey area. The acreage used for crops and pasture has steadily decreased in the past 20 years. Most steep mountainsides that were once used for corn or pasture have reverted to woodland, and other areas have been converted to urban uses.

The potential of the soils for increased production is fair. Nearly 12,000 acres in the survey area qualifies as prime farmland. An additional 5,150 acres is suited to crop production, including some sloping areas where adequate protection from erosion is needed. About 6,400 acres of hilly land is best suited to pasture and hay. Another 8,200 acres has favorable topography but may have surface stones or boulders that hinder its use as pasture or hayland. About half of this acreage is made up of Fairpoint and Bethesda soils in large areas that have been surface mined for coal.

Production also can be increased by extending the latest crop production technology to all of the cropland in the survey area. Differences in suitability and management result from differences in soil characteristics, such as fertility, erodibility, organic matter content, availability of water for plant growth, drainage, and flooding. Cropping systems, tillage, and field size also are important parts of management. This section describes the general principles of soil management that can be applied widely within the survey area.

Water erosion is a major concern on slopes of more than about 2 percent. Loss of the surface layer reduces fertility and the available water capacity and results in poor tilth. Erosion is especially harmful to soils that have a root-restricting layer within about 40 inches of the surface, such as Gilpin and Crossville soils. It is less harmful, though still a concern, on soils that have few root-restricting characteristics, such as Allegheny and Shelocta soils. Applications of fertilizer help to offset the lower fertility caused by erosion, but overcoming much of the damage is difficult or impractical. Controlling erosion minimizes the pollution of streams by sedimentation. Thus, water quality is improved for farm and city uses, for wildlife habitat, and for recreational uses.

Erosion-control practices provide a protective cover of crop residue or vegetation. Properly managed permanent pasture or hay can provide 80 percent or more of the protection needed. Crop rotations that alternate cultivated crops and meadows help to control erosion. Applying a system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year can reduce sheet erosion by one-half or more, as compared to fall plowing with a moldboard plow.

No-tillage systems that leave nearly all of the crop residue on the surface reduce the hazard of erosion. Contour farming and contour stripcropping can be used on fields that have smooth, uniform slopes. Terraces that divert surface runoff to safe outlets can be used in some fields.

Parallel terraces can be farmed much more easily than contour terraces. Deep and very deep soils that have few or no root-restricting characteristics, such as Allegheny and Shelocta soils, are better suited to terraces than soils that have bedrock near the surface, such as Gilpin and Sequoia soils. On the more shallow soils, the possible losses caused by exposing small infertile areas should be considered when the depth of cut and the design of the terrace system are determined.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous. In the uplands, most soils used for cultivated crops have a surface layer of silt loam or loam that is low in organic matter content. Examples are Gilpin, Jefferson, Sequoia, and Shelocta soils. Generally, tilling these soils weakens the soil structure and increases the degree of compaction and the extent of surface crusting. Tilling when the soils are too wet can further increase the degree of compaction, even below the plow layer. Subsoiling and varying the depth of plowing minimize compaction and the formation of traffic pans. Regular additions of crop residue, barnyard manure, and other organic material improve tilth and minimize surface crusting.

Most of the soils on the flood plains in the survey area have a surface layer of fine sandy loam or loam that is moderate or high in organic matter content. These soils retain favorable tilth under normal tillage operations. They are susceptible to compaction beneath the tillage zone. In some areas of Craigsville soils, excessive gravel in the plow layer restricts tillage.

Stones and boulders are a common feature in many of the colluvial soils in the survey area. In some places these soils cannot be tilled because they have too many stones and boulders. In other places the stones and boulders can be removed.

Soil fertility is medium in most of the soils on the flood plains and low in the soils on uplands. Almost all of the soils on uplands have excessive levels of acidity in the upper part of the root zone. Applications of lime are needed to raise the pH level of these soils for the adequate growth of most crops. Most of the soils on flood plains are naturally acid, but the levels may or may not affect crop growth in a given year. On all soils, the amount of lime and fertilizer to be applied should be based on the results of soil tests, the needs of the crops, and the expected level of yields. The Cooperative Extension Service can help to determine the kind and amount of lime and fertilizer to be applied.

Organic matter is an important source of nitrogen for crop growth. Also, it helps to maintain good tilth and the rate of water infiltration. The content of organic matter is low in most of the cultivated soils in the uplands and moderate in the soils on flood plains. The soils throughout the survey area have low levels of phosphorus and low or moderate levels of potassium unless heavy applications of fertilizer have been applied.

The soils along the river bottoms are occasionally flooded. Flooding generally occurs between December and June and is of brief duration. Flash flooding as a result of intensive rainfall can occur on the upper reaches of stream bottoms at any time of the year.

In soils that have a high water table, a drainage system is needed to reduce wetness during spring. Additional drainage measures are needed in some areas of Philo soils. Surface ditches or tile drains can be used if suitable outlets are available. In most areas of the poorly drained Bonnie soils, suitable outlets are not available. Even where outlets are available, draining these soils generally is only partly effective. As a result,

Figure 12.—Harvesting hay in an area of Shelbiana loam, occasionally flooded, along the Cumberland River. Shelocta-Kimper-Cloverlick complex, 35 to 75 percent slopes, very stony, is on the mountainside in the background.

the soils are best suited to pasture and wetland wildlife habitat.

Pasture and Hayland

About 10,000 acres in the survey area is used for hay and pasture (fig. 12). A successful livestock program depends on a forage program that can supply large quantities of homegrown feed of adequate quality. Such a program can furnish as much as 78 percent of the feed for beef cattle and 66 percent for dairy cattle *(18)*.

The soils in the survey area vary widely in their ability to produce forage because of differences in depth to bedrock, internal drainage, available water capacity, and many other properties. Grasses and legumes and grass-legume combinations vary widely in their ability to persist and provide forage on different soils. Selecting the plant species or mixture of species appropriate to the specific soil helps to realize the greatest returns and the maximum soil and water conservation.

Nearly level to sloping, deep or very deep, well drained soils should be planted to the highest producing forage species, such as alfalfa or a mixture of alfalfa and orchardgrass or of alfalfa and timothy. Sod-forming grasses, such as tall fescue and bluegrass, are needed to minimize erosion on the steeper soils. Alfalfa can be used with a cool-season grass where soils are at least 2 feet deep and are well drained. On soils that are less than 2 feet deep or are not well drained, clover-grass mixtures or pure grass stands should be used. Legumes can be established through renovation in sod that is dominated by grasses.

Plants should to be selected according to the kind of soil and the intended use. The plants selected should be those that provide maximum quality and versatility in the forage program. Legumes generally produce higher quality feed than grasses and should be used to the maximum extent possible. The taller legumes, such as alfalfa and red clover, are more versatile than other legumes, such as white clover, which is used primarily for grazing. Grasses, such as orchardgrass, timothy, and tall fescue, are better suited to hay and silage.

Tall fescue is an important cool-season grass that is suited to a wide range of soil conditions. It is used for both pasture and hay. Plant growth occurring from August to November is commonly permitted to accumulate in the field for deferred grazing during late fall and winter. Nitrogen fertilizer is needed for maximum production during the rest period. The desired production levels should determine the rates of application.

On some of the pasture or hayland in the survey area, reestablishment is needed. In many areas renovation or other improvements, such as brush control and protection from overgrazing, are needed. Renovation is one way to increase the yields of pasture and hay fields and maintain a good stand of grasses. It improves the fields by partial destruction of the sod followed by applications of lime and fertilizer and seeding to reestablish desirable forage plants. Including legumes in the grass fields provides high-quality feed.

Additional information about pasture and hayland management is available at the local office of the Soil Conservation Service or the Kentucky Cooperative Extension Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Kentucky Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for use as cropland *(47)*. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major, and generally expensive, landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode, but they have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless a close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

There are no subclasses in class I because the soils of this class have few limitations. The soils in class V are subject to little or no erosion, but they have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation. Class V contains only the subclasses indicated by *w, s,* or *c (47).*

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

Charles A. Foster, forester, Soil Conservation Service, helped prepare this section.

Soils vary in their ability to produce trees. Available water capacity and depth of the root zone have major effects on tree growth. Fertility and texture also influence tree growth. Elevation, aspect, and climate determine the kinds of trees that can grow on a site. Elevation and aspect are of particular importance in mountainous areas.

This soil survey can be used by woodland managers planning ways to increase the productivity of forest land. Some soils respond better to applications of fertilizer than others, and some are more susceptible to landslides and erosion after roads are built and timber is harvested. Some soils require special reforestation efforts. In the section "Detailed Soil Map Units," the description of each map unit in the survey area suitable for timber includes information about productivity, limitations in harvesting timber, and management concerns in producing timber. Table 8 summarizes this forestry information and rates the soils for a number of factors to be considered in management. *Slight, moderate*, and *severe* are used to indicate the degree of the major soil limitations to be considered in forest management.

Ratings of the *erosion hazard* indicate the probability that damage may occur if site preparation or harvesting activities expose the soil. The risk is *slight* if no particular preventive measures are needed under ordinary conditions; *moderate* if erosion-control measures are needed for particular silvicultural activities; and *severe* if special precautions are needed to control erosion for most silvicultural activities. Ratings of *moderate* or *severe* indicate the need for construction of higher standard roads, additional maintenance roads, additional care in planning harvesting and reforestation activities, or the use of special equipment.

Ratings of *equipment limitation* indicate limits on the use of forest management equipment, year-round or seasonal, because of such soil characteristics as slope, wetness, stoniness, or susceptibility of the surface layer to compaction. As slope gradient and length increase, it becomes more difficult to use wheeled equipment. On the steeper slopes, tracked equipment is needed. On the steepest slopes, even tracked equipment cannot be operated and more sophisticated systems are needed. The rating is *slight* if equipment use is restricted by soil wetness for less than 2 months and if special equipment is not needed. The rating is *moderate* if slopes are so steep that wheeled equipment cannot be operated safely across the slope, if wetness restricts equipment use from 2 to 6 months per year, if stoniness restricts the use of ground-based equipment, or if special equipment is needed to prevent or minimize compaction. The rating is *severe* if slopes are so steep that tracked equipment cannot be operated safely across the slope, if wetness restricts equipment use for more than 6 months per year, if stoniness restricts the use of ground-based equipment, or if special equipment is needed to prevent or minimize compaction. Ratings of moderate or severe indicate a need to choose the most suitable equipment and to carefully plan the timing of harvesting and other management activities.

Ratings of *seedling mortality* refer to the probability of the death of naturally occurring or properly planted seedlings of good stock in periods of normal rainfall, as influenced by kinds of soil or topographic features. Seedling mortality is caused primarily by too much water or too little water. The factors used in rating a soil for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, rooting depth, and the aspect of the slope. The mortality rate generally is highest on soils that have a sandy or clayey surface layer. The risk is *slight* if, after site preparation, expected mortality is less than 25 percent; *moderate* if expected mortality is between 25 and 50 percent; and *severe* if expected mortality exceeds 50 percent. Ratings of moderate or severe indicate that it may be necessary to use containerized or larger than usual planting stock or to make special site preparations, such as bedding, furrowing, installing a surface drainage system, and providing artificial shade for seedlings. Reinforcement planting is often needed if the risk is moderate or severe.

Ratings of *plant competition* indicate the likelihood of the growth or invasion of undesirable plants. Plant competition is more severe on the more productive soils, on poorly drained soils, and on soils having a restricted root zone that holds moisture. The risk is *slight* if competition from undesirable plants hinders adequate natural or artificial reforestation but does not necessitate intensive site preparation and maintenance. The risk is *moderate* if competition from undesirable plants hinders natural or artificial reforestation to the extent that intensive site preparation and maintenance are needed. The risk is *severe* if competition from undesirable plants prevents adequate natural or artificial reforestation unless the site is intensively prepared and maintained. A moderate or severe rating indicates the need for site preparation to ensure the development of an adequately stocked stand. Managers must plan site preparation measures to ensure reforestation without delays.

The *potential productivity* of *common trees* on a soil is expressed as a *site index* and a *volume* number. Common trees are listed in the order of their observed general occurrence. Generally, only two or three tree species dominate. The first tree listed for each soil is the indicator species for that soil. An indicator species is a tree that is common in the area and that is generally the most productive on a given soil.

The *site index* is determined by taking height measurements and determining the age of selected trees within stands of a given species. This index is the average height, in feet, that the trees attain in a specified number of years. This index applies to fully stocked, even-aged, unmanaged stands. The site indices in table 8 are based on regional studies *(4, 10, 11, 15, 16, 25, 29, 34, 35)*.

The *volume* is the yield likely to be produced by the most important trees, expressed in cubic feet per acre per year calculated at the age of culmination of mean annual increment.

Trees to plant are those that are used for reforestation or, under suitable conditions, natural regeneration. They are suited to the soils and can produce a commercial wood crop. The desired product, topographic position (such as a low, wet area), and personal preference are three factors among many that can influence the choice of trees for use in reforestation.

Bell and Harlan Counties are in the mixed mesophytic forest region of the eastern deciduous forest *(9)*. Steep mountain slopes make up about 90 percent of the survey area and, except for areas recently surface mined for coal, are forested. Maple, beech, yellow poplar, oak, and hickory are the dominant tree species.

Much of the forest land is owned by large corporations, which are primarily interested in the coal resources. Some of the forest land is in small private holdings. The Kentucky Ridge State Forest and the Kentenia State Forest, which make up a total of about 16,000 acres, are managed for multiple uses. Almost 16,000 acres of forest land is in the Cumberland Gap National Historical Park, Kingdom Come State Park, and Pine Mountain State Park. Other forest land owned by state, federal, and local agencies makes up about 4,000 acres. Most of the publicly owned forest land is in the Helechawa-Alticrest-Varilla general soil map unit.

Currently, three large sawmills operate in the survey area. Tree products, such as rough-sawn boards, mine props, shims, and blocking, are cut at several small mills (fig. 13). Mine props and fuel wood are cut by many landowners. Markets are insufficient for much of the low-quality hardwood.

Forest Species

The presettlement forest of the survey area was a mixed mesophytic deciduous forest, which flourished, particularly in the higher mountains, in regard to number of tree species, size of trees, and variety of forest types *(7, 8, 9)*. In the present-day mixed mesophytic forest association, several species generally are in a stand of trees. The most common species are sugar maple, yellow poplar, black locust, yellow buckeye, and basswood. Other species are northern red oak, red maple, white oak, chestnut oak, cucumbertree, American beech, eastern hemlock, black cherry, birch, magnolia, and hickory. The mixed mesophytic forest covers almost all of the Highsplint-Cloverlick-Guyandotte general soil map unit. It is on cool slopes and in coves.

Oak forests are in the drier areas, such as the south- and west-facing sides of mountains and the tops of mountains. The most common species are chestnut oak, scarlet oak, white oak, red maple, blackgum, and hickory. Oak-pine forests on Pine and Cumberland

Figure 13.—Yellow poplar, oak, and beech logs. The logs are used for lumber and other products, such as shims used in mining.

Mountains are also in the drier areas. Pitch pine, Virginia pine, and shortleaf pine are mixed with the oaks.

Soil and Tree Relationships

A knowledge of soils helps to provide a basic understanding of the distribution of tree species on the landscape and tree growth. Some of these relationships are readily recognized. For example, yellow poplar grows well on deep or very deep, moist soils and scarlet oak or pine is common where the rooting depth is restricted or the moisture supply is limited. The soil serves as a reservoir for moisture, provides an anchor for roots, and supplies most of the available nutrients. Soil properties that directly or indirectly affect these growth requirements include organic matter content, reaction, fertility, drainage, texture, structure, depth, and landscape position. Elevation and aspect are of particular importance in mountainous areas.

The available water capacity is primarily influenced by texture, organic matter content, rooting depth, and content of rock fragments. In the survey area, available water capacity is a limitation affecting tree growth only in the shallow soils, such as Totz soils, because of the fairly even and abundant summer rainfall. Changing the physical limitations of the soils is difficult, but timber stand improvement and thinning are useful in management.

All of the soils in the survey area, except for the shallowest ones, provide an adequate anchor for tree roots. The susceptibility to windthrow, or the uprooting of trees by the wind, is not a major management concern on most soils.

The available supply of nutrients affects tree growth. Mineral horizons in the soil are important. Mineralization of the humus releases nitrogen and other nutrients to plants. Calcium, magnesium, and potassium are held within the humus. Very small amounts of these nutrients are made available by the weathering of clay and silt particles. Most of the soils in the uplands have been leached and have only small amounts of nutrients below the surface layer. Where the surface layer is thin, as in Shelocta and Gilpin soils, careful management is needed during site preparation to ensure that the surface layer is not removed or degraded.

The living plant community is part of the nutrient reservoir. The decomposition of leaves, stems, and other organic material recycles the nutrients that have accumulated in the forest ecosystem. Fire, excessive trampling by livestock, and erosion can result in the loss of these nutrients. Forest management should include prevention of wildfires and protection from overgrazing.

Aspect and landscape position influence the amount of available sunlight, air drainage, soil temperature, and moisture retention. North- and east-facing slopes, or cool slopes, are better suited to tree growth than south- and west-facing slopes, or warm slopes. Differences in site index values can be as much as 10 feet. Most of the soils on cool slopes have an A horizon that is thicker and has more humus and clay than that of the soils on warm slopes. Examples of soils on cool slopes are Cloverlick, Cutshin, Guyandotte, and Kimper. These soils have a slightly higher capacity to hold water and a much higher capacity to hold nutrients than the soils on warm slopes. The mean annual soil temperature is about 2 degrees F lower on the cool slopes. The difference in temperature is most prevalent during the dormant season. Because less sunlight falls on the canopy in areas of the cool slopes, the air temperature in the canopy and the transpiration rate are lower and less water is needed.

Soils on the lower slopes may receive additional water because of internal waterflow. On the very steep uplands, much of the water movement during periods of saturation occurs as lateral flow within the subsoil.

Soil and air temperatures are lower on the upper slopes than on the lower slopes. The temperature decreases is about 1 degree F per 550-foot change in elevation. The soils at the base of warm slopes and the soils on the adjacent cool slopes are similar, probably because of the shading effect of the ridge and possibly because of air drainage. These similar soils are mapped together.

Nutrients, water, and landscape position largely determine which tree species grows on a particular soil. For example, sugar maple-basswood forest is on soils that have the highest fertility levels and a high moisture content *(33)*. Beech grows on soils that have a high moisture content and intermediate fertility levels. Chestnut oak-red maple forest is on soils that have low fertility levels and a low moisture content. Scarlet oak-pine forest is on soils that have very low fertility levels and a very low moisture content.

Recreation

The recreational facilities in Bell and Harlan Counties include swimming pools, golf courses, hunting and fishing areas, campgrounds, ballfields, game courts, trails, historic sites, and picnic areas. Because of scenic qualities and a small amount of minable coal, the Helechawa-Alticrest-Varilla general soil map unit is well suited to extensive recreational areas. Most of the parks and state forests in the survey area are in this map unit.

The Cumberland Gap National Historical Park is the most frequently visited public recreational area in Bell and Harlan Counties. About 12,000 acres of this park is included in the survey area. The park offers opportunities for hiking, picnicking, and trail riding and for sightseeing on the historic route through the Cumberland Gap. It also includes a restored farm community. Kingdom Come State Park, near Cumberland, offers opportunities for picnicking and hiking. Pine Mountain State Park, near Pineville, has lodging facilities, camp areas, picnic areas, a golf course, and hiking trails. About 1,250 acres in the survey area is in Kingdom Come State Park; 2,500 acres is in Pine Mountain State Park; 12,000 acres is in the Kentucky Ridge State Forest, southwest of Pineville; and 3,750 acres is in the Kentenia State Forest, northeast of Harlan. Cranks Creek Lake, Cranks Creek Wildlife Management Area, and Martins Fork Lake, which are southeast of Harlan, together make up about 3,950 acres.

In table 9, the soils of the survey area are rated according to the limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines.

The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes, stones, or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Gregory K. Johnson, resource specialist, Soil Conservation Service, helped prepare this section.

The principal kinds of wildlife in Bell and Harlan Counties are cottontail rabbit, gray squirrel, raccoon, opossum, skunk, red fox, gray fox, white-tailed deer, turkey, and grouse. Approximately 34 species of mammals, 110 species of breeding birds, and 33 species of reptiles and amphibians inhabit the survey area. Harlan County has no endangered species; Bell County has the endangered Indiana bat and the endangered red-cockaded woodpecker.

The flora and fauna of Bell and Harlan Counties interest photographers and birdwatchers. The streams are inhabited by a variety of warm-water game fish, pan fish, and rough fish common throughout Kentucky, such as smallmouth bass and bluegill. Cannon Lake, Cranks Creek Lake, Martins Fork Lake, and part of Fern Lake are the major impoundments. Approximately 300 private farm ponds and small lakes in the survey area have been stocked with largemouth bass, channel catfish, and bluegill.

Woodland wildlife habitat makes up about 90 percent of the survey area. It is mainly in the mountainous areas. Openland wildlife habitat makes up about 9 percent of the survey area. It is along the valleys and in some areas that have been surface mined for coal. Urban and other built-up areas make up the rest of the area. Small wetland areas generally are along the edges of streams, ponds, and lakes. A few wetlands are in depressions on flood plains, mainly in areas of Bonnie silt loam, occasionally flooded.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, ironweed, and ragweed.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and huckleberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian olive, autumn olive, crabapple, and silky dogwood.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, cedar, and hemlock.

Wetland plants are annual and perennial, wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, rushes, and sedges.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

Most of the steep or very steep soils in the survey area and many of the underlying thick strata of shale and siltstone are unstable. Landslide scars or rotational slumps occur in many mountainous areas. Oversteepening artificial cuts, such as those along roads and in surface mines, increases the chance of landslides or slumps. Other areas, such as the upper part of alluvial fans, may be in the path of debris avalanches. These avalanches, consisting of mostly soil material and rock fragments, can occur after exceptionally heavy rainfall. They begin in or near the grooves on mountainsides and eventually deposit the soil material and rock fragments on toe slopes or flood plains.

The information in this section can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. Depth to a high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, depth to a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost-action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, depth to a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and that good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, depth to a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, depth to a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, depth to a water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and releases a variety of plant nutrients as it decomposes.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives the restrictive features that affect each soil for drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 20.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SM-SC.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20, or higher, for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 20.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index generally are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate, or component, consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence the shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of movement of water through the soil when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage in each major soil layer is stated in inches of water per inch of soil. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons per acre per year.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep or very deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep, deep, or very deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have high a shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflowing streams or by runoff from adjacent slopes (fig. 14). Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in swamps and marshes or in a closed depression is considered ponding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

Frequency, duration, and probable dates of occurrence are estimated. Frequency generally is expressed as *none, rare, occasional,* or *frequent. None* means that flooding is not probable. *Rare* means that flooding is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year). *Occasional* means that flooding occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year). *Frequent* means that flooding occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 days to 1 month), and *very long* (more than 1 month). The time of year that floods are most likely to occur is expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding is based on evidence in the soil profile, namely, thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons characteristic of soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a

Figure 14.—An area of Shelbiana loam, occasionally flooded, along the Cumberland River. Flooding is a hazard along the streams in the survey area.

saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table— that is, *perched* or *apparent;* and the months of the year that the water table commonly is highest. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. "More than 6.0" indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severely corrosive environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and the amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

The results of physical analysis of several typical pedons in the survey area are given in table 18 and the results of chemical analysis in table 19. The data are for soils sampled at carefully selected sites. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." Most soil samples were analyzed by the Soil Survey Laboratory, Lincoln, Nebraska. Samples of the Shelbiana soil were analyzed by the Kentucky Agricultural Experiment Station, Lexington, Kentucky.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an oven-dry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods *(50)*.

Rock fragments—(2-20 mm fraction) weight estimates of the percentages of all materials less than 20 mm.
Rock fragments—(more than 2 mm fraction) volume estimate of the percentage of all material greater than 2 mm (3B2).
Sand—(0.05-2.0 mm fraction) weight percentages of materials less than 2 mm (3A1).
Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all materials less than 2 mm (3A1).
Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of materials less than 2 mm (3A1).
Organic carbon—dichromate, ferric sulfate titration (6A1a).
Extractable cations—ammonium acetate pH 7.0, uncorrected; calcium (6N2), magnesium (6O2), sodium (6P2), potassium (6Q2).
Extractable acidity—barium chloride-triethanolamine I (6H1a).
Cation-exchange capacity—ammonium acetate, pH 7.0 (5A1a).
Cation-exchange capacity—sum of cations (5A3a).
Base saturation—ammonium acetate, pH 7.0 (5C1).
Base saturation—sum of cations, TEA, pH 8.2 (5C3).
Reaction (pH)—1:1 water dilution (8C1a).
Reaction (pH)—calcium chloride (8C1e).
Iron—dithionate-citrate extract (6C2b).
Carbonate as calcium carbonate—manometric (6E1b).

Engineering Index Test Data

Table 20 shows laboratory test data for two pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." The soil samples were tested by the Soil Mechanics Laboratory, South National Technical Center, Fort Worth, Texas.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM); and Specific gravity—D 854-91 (ASTM).

Selected Diagnostic Properties

Some soil properties are readily observed or measured. Others require a long period of observation or expensive or time-consuming laboratory measurement. In this section selected properties useful in the classification of the soils in the survey area are summarized. The summaries are based on the data from 31 soil profiles sampled for laboratory analysis in this survey area and on data from similar survey areas.

Soil temperature.—The temperature of the soil affects

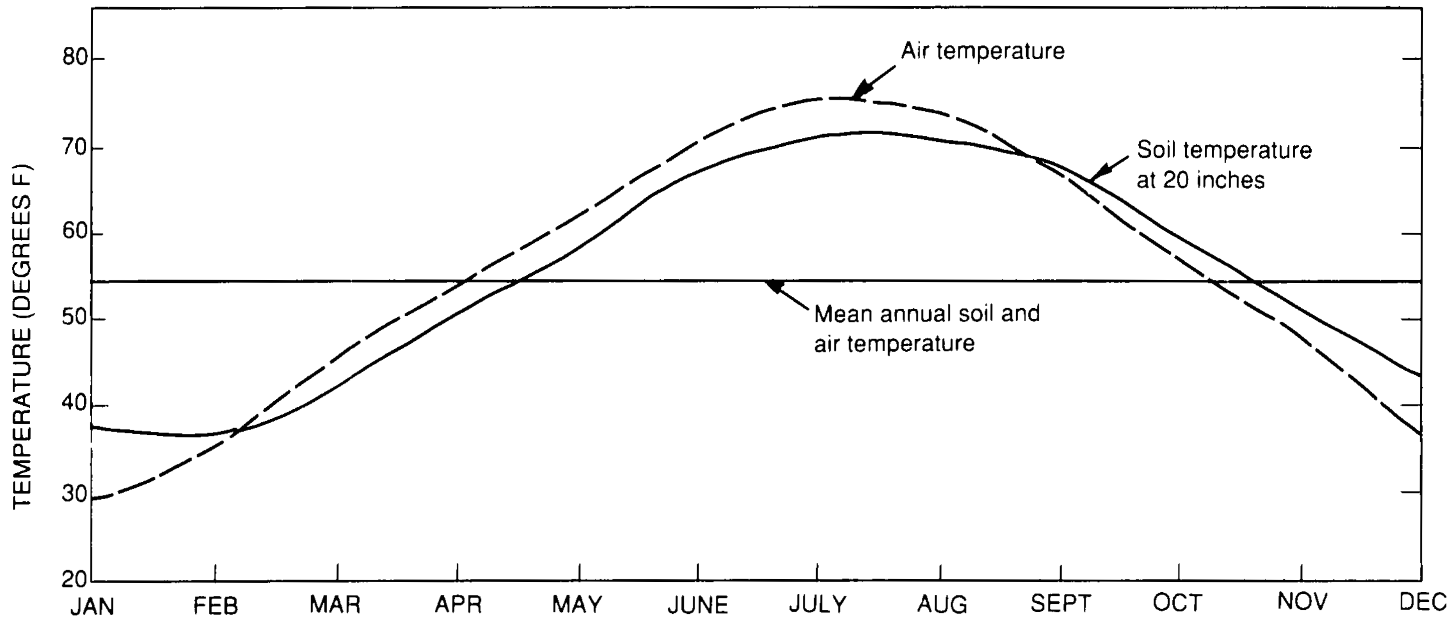

Figure 15.—Mean monthly and annual soil and air temperature in an area of Shelocta soils at Middlesboro, Kentucky. Data recorded at Cumberland Gap National Historical Park, 1976-1986.

biological activity and the chemical and physical processes in the soil. For example, root growth for most plants and seed germination are impossible at a temperature below about 41 degrees F *(49)*. The temperature of the soil varies with the air temperature but is not subject to so many day-to-day fluctuations. The average annual soil temperature is related to the average annual air temperature but is affected to some extent by rainfall, snow cover, shading, fog, layers of leaf litter, and the slope aspect and gradient *(49)*. The mean annual soil temperature at Middlesboro, Kentucky, is about 54.5 degrees F.

The seasonal fluctuations in soil and air temperature, as measured in an area of Shelocta soils at Cumberland Gap National Historical Park in Middlesboro, are plotted in figure 15. Both the air and soil temperature follow a sine curve in which the amplitude—the distance from the peaks to the valleys—of the soil temperature is less than that of the air temperature. The average winter temperature of the soils is 38.8 degrees F, and the average summer temperature is 69.5 degrees F. For the same periods, air temperatures are 34.1 degrees F and 73.3 degrees F.

Within the survey area, soil temperature varies according to elevation and aspect. An area on Black Mountain east of Cumberland, in Harlan County, was used to measure this variation. At two sites at elevations of 2,040 feet and 3,820 feet, soil temperatures were recorded on opposing aspects. The measurements were made four times a year at a depth of about 20 inches. At both sites the north or northeast aspect was cooler than the south or southwest aspect (fig. 16). This difference was greatest during the dormant season. The soils averaged about 3 degrees F cooler at the higher elevation. These data agree with other temperature studies *(19)*.

Particle-size distribution.—The fine-earth fraction of the soils in the survey area is commonly sandy loam, loam, or silt loam. In a few samples it is loamy sand, clay loam, silty clay loam, or silty clay. The content of sand generally is between 20 and 65 percent. The content of clay generally is between 8 and 38 percent. Sandier soils contain less clay than soils that have a low content of sand.

Clay minerals.—Results from the analysis of clay mineralogy in the Bt1 horizon of the typical pedon of Gilpin soils shows that the clay fraction contains kaolinite, vermiculite, and mica and smaller amounts of lepidocrocite. No one clay mineral dominates. The amount of kaolinite, as determined by differential thermal analysis (DTA), is 12 percent. These findings are comparable to a study in McCreary County, Kentucky, and Morgan County, Tennessee, to the west and southwest of the survey area *(19)*. In that study vermiculite, mica, interstratified vermiculite with varying amounts of hydroxy-interlayering, kaolinite, and trace amounts of quartz and lepidocrocite were identified. The amount of kaolinite, as determined by DTA, ranged from 15 to 35 percent.

In Pike County, Kentucky, and Boone and Wyoming Counties, West Virginia, determinations of clay mineralogy have been made from selected horizons. Kaolinite and mica were identified in every sample. Most samples also contained vermiculite. Several samples contained vermiculite-chlorite, lepidocrocite, or vermiculite with varying amounts of hydroxy-interlayering. The amount of kaolinite, as determined by DTA, ranged from 2 to 26 percent.

Minerals in sand and silt.—Quartz is the dominant mineral in both the sand and silt fractions of the soils in the survey area. The content of quartz ranges from about 50 to 100 percent. It is lowest in soils that formed in material weathered from shale, siltstone, and sandstone of the Breathitt Group and highest in soils that formed in material weathered from quartzose sandstone of the Lee Formation. Other minerals in the soils are muscovite, biotite, potassium feldspar, mica, and chlorite. Some soils have trace amounts of zircon and tourmaline. Soils that have a high content of potassium feldspar can supply a sufficient amount of potassium for many crops. Mica, muscovite, and biotite also supply some potassium, but the rate of release is too slow for most crops. Quartz, zircon, and tourmaline are very resistant to weathering and do not supply any plant nutrients.

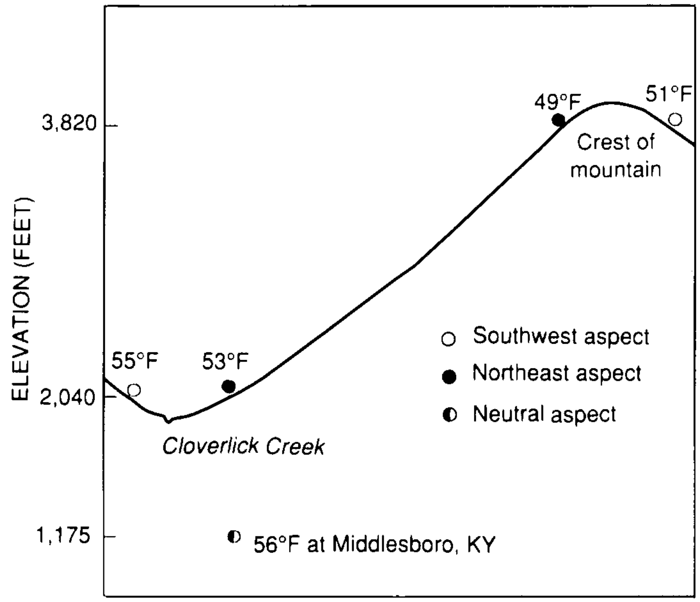

Figure 16.—The effects of elevation and aspect on average soil temperature. Data recorded quarterly during the period December 1984 to September 1988.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(49)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or on laboratory measurements *(43)*. Table 21 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders, primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Fluvaquents (*Fluv*, meaning flood plain, plus *aquent*, the suborder of the Entisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Fluvaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, acid, mesic Typic Fluvaquents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. There can be some variation in the texture of the surface layer or of the substratum within a series.

The orders in this survey area are Entisols, Inceptisols, Mollisols, Ultisols, and Alfisols.

Entisols have been little affected by soil-forming processes. A thin A horizon is the only distinct pedogenic horizon in these soils.

Fluvaquents are very deep, poorly drained soils that have a thin A horizon. Typic Fluvaquents are fine-silty and have mixed mineralogy. They include Bonnie soils in wet, swampy areas on flood plains. They are not extensive in the survey area.

Psamments are shallow, somewhat excessively drained soils that have a thin A horizon. Lithic Quartzipsamments are sandy and have siliceous mineralogy. They include Totz soils on mountains.

Udorthents are deep or very deep, well drained soils that have a very thin A horizon. The Udorthents in areas of cuts and fill that are associated with urban land were not classified below the great group. Typic Udorthents are loamy-skeletal and have mixed mineralogy. They include Fairpoint and Bethesda soils in areas that have been surface mined for coal.

Inceptisols and *Mollisols* in this survey area have a cambic horizon. Inceptisols generally have a very low degree of base saturation. The Mollisols have a higher degree of base saturation throughout than the Inceptisols.

Dystrochrepts are moderately deep to very deep, moderately well drained to somewhat excessively drained and generally have a thin A horizon. The subsoil commonly is yellowish brown. Typic Dystrochrepts are coarse-loamy or loamy-skeletal and have mixed or siliceous mineralogy. They include Alticrest, Helechawa, Highsplint, and Varilla soils on uplands. Fluvaquentic and Fluventic Dystrochrepts are coarse-loamy or loamy-skeletal and have mixed mineralogy. They include Craigsville, Philo, and Pope soils on flood plains. Umbric Dystrochrepts have a moderately thick A horizon. The subsoil commonly is dark yellowish brown in the upper part and yellowish brown in the lower part. These soils are fine-loamy or loamy-skeletal and have mixed or siliceous mineralogy. They include Cloverlick, Crossville, and Kimper soils on moist uplands.

Haplumbrepts are deep and very deep, well drained soils that have a thick A horizon and a moderately thick subsoil. The subsoil commonly is brown or dark yellowish brown. Typic Haplumbrepts are fine-loamy or loamy-skeletal and have mixed mineralogy. They include Cutshin and Guyandotte soils on moist uplands.

Hapludolls are very deep, well drained soils that have a thick A horizon and a moderately thick subsoil. The subsoil commonly is brown or dark yellowish brown. Typic Hapludolls are loamy-skeletal and have mixed mineralogy. They include Sharondale soils, which are on moist uplands and formed in colluvium derived from sandstone, siltstone, and calcareous shale. They are not extensive in the survey area.

Ultisols and *Alfisols* have an argillic horizon, which exhibits evidence of clay translocation. The Ultisols are leached to a greater degree than the Alfisols.

Hapludalfs are very deep, well drained soils that have a moderately thick A horizon and a thick subsoil. The subsoil commonly is brown to yellowish brown. Ultic Hapludalfs are fine-loamy and have mixed mineralogy. They include Renox soils, which are on moist uplands and formed in colluvium derived from sandstone, siltstone, and shale. They are not extensive in the survey area.

Hapludults are moderately deep to very deep, well drained soils that have a thin A horizon and a thin or moderately thick subsoil. The subsoil commonly is yellowish brown. Typic Hapludults are fine-loamy or clayey and have mixed or siliceous mineralogy. They include Allegheny, Gilpin, Jefferson, Sequoia, and Shelocta soils on uplands and stream terraces.

Palehumults are very deep, well drained soils that have a thick A horizon and a thick subsoil. The subsoil commonly is brown or dark yellowish brown. Typic Palehumults are fine-silty and have mixed mineralogy. They include Shelbiana soils on flood plains.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The locations of the typical pedons in this survey area are indicated by a special symbol on the soil maps. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(42)*. Designations for horizons and many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(49)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Allegheny Series

The Allegheny series consists of very deep, well drained soils on stream terraces and alluvial fans. Permeability is moderate. These soils formed in loamy alluvium. Slopes range from 2 to 8 percent. Allegheny soils are fine-loamy, mixed, mesic Typic Hapludults.

Allegheny soils are associated on the landscape with the Jefferson and Shelocta soils on foot slopes and with the Shelbiana, Philo, and Pope soils on flood plains. Jefferson and Shelocta soils do not have waterworn pebbles. Shelbiana soils have an umbric epipedon. Philo and Pope soils are coarse-loamy.

Typical pedon of Allegheny loam, 2 to 8 percent slopes; on a convex slope of 4 percent on an old garden site; 50 feet north of Kentucky Highway 188 and 1,950 feet west of the bridge over Yellow Creek; about 1.1 miles southwest of Colmar, in Bell County; Middlesboro North quadrangle; Kentucky coordinates 2,600,200 feet east and 124,450 feet north:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam; moderate very fine granular structure; friable; common fine roots; less than 1 percent gravel; neutral; abrupt irregular boundary.

BE—7 to 14 inches; light yellowish brown (2.5Y 6/4) loam; moderate fine subangular blocky structure; friable; common fine roots; less than 1 percent gravel; neutral; clear smooth boundary.

Bt1—14 to 22 inches; light olive brown (2.5Y 5/4) clay loam; moderate fine subangular blocky structure;

friable; few fine roots; few faint clay films on faces of peds; less than 1 percent gravel; slightly acid; gradual smooth boundary.

Bt2—22 to 31 inches; yellowish brown (10YR 5/6) clay loam; moderate fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; less than 1 percent gravel; strongly acid; gradual smooth boundary.

Bt3—31 to 39 inches; strong brown (7.5YR 5/8) clay loam; moderate fine subangular blocky structure; firm; few fine roots; common distinct yellowish red (5YR 5/6) clay films on faces of peds; less than 1 percent gravel; very strongly acid; gradual smooth boundary.

BC—39 to 60 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct brown (10YR 5/3) mottles; weak medium subangular blocky structure; firm; few fine roots; few distinct strong brown (7.5YR 5/6) clay films on faces of peds; less than 1 percent gravel; very strongly acid.

The thickness of the solum ranges from 30 to more than 60 inches. The depth to bedrock is 60 inches or more. Rock fragments, commonly gravel, make up 0 to 15 percent of the A, BE, and Bt horizons and 0 to 35 percent of the BC horizon. Reaction is extremely acid to strongly acid throughout the profile unless the soils have been limed.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. Some pedons have an A horizon. This horizon is less than 5 inches thick. It has value of 3 to 5 and chroma of 1 to 3. It is loam.

The BE horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6, and chroma of 4 to 8. It is silt loam or loam.

The Bt horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 or 5, and chroma of 4 to 8. In some pedons it is mottled in shades of brown, red, or yellow in the lower part. This horizon is clay loam, sandy clay loam, loam, silt loam, or silty clay loam. The BC horizon has colors and textures similar to those of the Bt horizon.

Some pedons have a C horizon. This horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 or 5, and chroma of 4 to 8. In most pedons it is mottled in shades of brown, gray, yellow, or olive. The fine-earth fraction is fine sandy loam, loam, sandy clay loam, or clay loam. The content of rock fragments is similar to that in the BC horizon.

Alticrest Series

The Alticrest series consists of moderately deep, somewhat excessively drained soils on mountains. Permeability is moderately rapid. These soils formed in loamy material weathered from sandstone and siltstone. Slopes range from 20 to 40 percent. Alticrest soils are coarse-loamy, siliceous, mesic Typic Dystrochrepts.

Alticrest soils are associated on the landscape with Helechawa, Totz, Jefferson, and Varilla soils. Helechawa, Jefferson, and Varilla soils are deep or very deep. Totz soils are shallow.

Typical pedon of Alticrest fine sandy loam, in an area of Alticrest-Totz-Helechawa complex, rocky, 20 to 55 percent slopes; on a south-facing, convex slope of 25 percent, at an elevation of 2,740 feet, in a forest of scarlet oak, chestnut oak, and pitch pine; 900 feet south-southeast of an overlook on the Little Shepherd Trail at the headwaters of Banks Branch; about 1.7 miles northeast of Totz, in Harlan County; Louellen quadrangle; Kentucky coordinates 2,774,100 feet east and 241,100 feet north:

Oi—2 inches to 0; leaves, roots, and twigs; abrupt wavy boundary.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) fine sandy loam; moderate fine granular structure; friable; many fine roots; about 10 percent gravel; very strongly acid; abrupt irregular boundary.

Bw1—2 to 12 inches; yellowish brown (10YR 5/4) fine sandy loam; weak fine subangular blocky structure; friable; common fine roots; about 10 percent gravel; strongly acid; gradual wavy boundary.

Bw2—12 to 22 inches; yellowish brown (10YR 5/6) loam; weak medium subangular blocky structure; friable; few fine and medium roots; about 10 percent gravel; very strongly acid; gradual wavy boundary.

BC—22 to 33 inches; yellowish brown (10YR 5/8) gravelly fine sandy loam; weak fine subangular blocky structure; very friable; few fine roots; about 15 percent gravel; very strongly acid; clear wavy boundary.

R—33 inches; sandstone bedrock; weakly cemented in the upper 2 inches.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. Rock fragments, commonly gravel, make up 0 to 15 percent of each horizon. Reaction is very strongly acid or strongly acid throughout the profile.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 8. It is sandy loam, loam, or fine sandy loam. The BC horizon has colors and textures similar to those of the Bw horizon.

Some pedons have a C horizon. This horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 to 6. It is sand, loamy sand, or sandy loam.

Bethesda Series

The Bethesda series consists of very deep, well drained soils on mountains. Permeability is moderately slow. These soils formed in stony, loamy, acid regolith in surface-mined areas or in other highly disturbed areas. Slopes range from 2 to 70 percent. Bethesda soils are loamy-skeletal, mixed, acid, mesic Typic Udorthents.

Bethesda soils are associated on the landscape with Fairpoint soils. Fairpoint soils are nonacid.

Typical pedon of Bethesda very channery loam, in an area of Fairpoint and Bethesda soils, 20 to 70 percent slopes; on a slope of 55 percent in a forest of red maple and yellow poplar; 6,200 feet north of where Kentucky Highway 74 crosses Morgan Hollow; about 1 mile northwest of Pruden, in Bell County; Eagan quadrangle; Kentucky coordinates 2,541,950 feet east and 103,600 feet north:

A—0 to 5 inches; yellowish brown (10YR 5/4) very channery loam; moderate medium granular structure; friable; common fine roots; about 35 percent rock fragments; extremely acid; clear wavy boundary.

AC—5 to 12 inches; grayish brown (2.5Y 5/2) very channery silt loam; weak medium subangular blocky structure; friable; few medium roots; about 50 percent rock fragments; very strongly acid; diffuse irregular boundary.

C1—12 to 30 inches; yellowish brown (10YR 5/6) very channery silt loam; massive; friable; very few medium roots; about 50 percent rock fragments; very strongly acid; gradual irregular boundary.

C2—30 to 60 inches; yellowish brown (10YR 5/4) extremely channery silt loam; massive; friable; about 65 percent rock fragments; very strongly acid.

The depth to bedrock is 60 inches or more. Rock fragments, mostly channers and flagstones, make up 15 to 60 percent of the A and AC horizons and 35 to 80 percent of the C horizon. Reaction is extremely acid to strongly acid throughout the profile.

The A or Ap horizon has hue of 7.5YR, 10YR, 2.5Y, or 5Y, value of 3 to 6, and chroma of 1 to 8, or it is neutral in hue and has value of 3 to 6. The fine-earth fraction is loam. The AC horizon has colors and textures similar to those of the Ap horizon.

The C horizon has hue of 7.5YR, 10YR, 2.5Y, or 5Y, value of 3 to 6, and chroma of 1 to 8, or it is neutral in hue and has value of 3 to 6. The fine-earth fraction is silt loam, silty clay loam, loam, or clay loam.

Bonnie Series

The Bonnie series consists of very deep, poorly drained soils on flood plains. Permeability is moderately slow. These soils formed in silty alluvium. Slopes are 0 to 1 percent. Bonnie soils are fine-silty, mixed, acid, mesic Typic Fluvaquents.

Bonnie soils are associated on the landscape with Shelbiana, Pope, Philo, and Craigsville soils. Shelbiana, Pope, and Craigsville soils are well drained or somewhat excessively drained. Philo soils are moderately well drained.

Typical pedon of Bonnie silt loam, occasionally flooded; on a smooth slope of 1 percent in a field of grasses, rushes, and sedges; 1,000 feet north of the Middlesboro-Bell County Airport office; Middlesboro South quadrangle; Kentucky coordinates 2,591,100 feet east and 107,500 feet north:

A—0 to 4 inches; grayish brown (2.5Y 5/2) silt loam; moderate fine granular structure; friable; many very fine roots; strongly acid; abrupt wavy boundary.

Bg1—4 to 15 inches; light brownish gray (2.5Y 6/2) silt loam; common fine prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; common very fine roots; very strongly acid; clear wavy boundary.

Bg2—15 to 24 inches; light brownish gray (2.5Y 6/2) silt loam; many medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few very fine roots; common prominent black iron and manganese coatings on peds; strongly acid; gradual wavy boundary.

Cg1—24 to 34 inches; light brownish gray (2.5Y 6/2) silt loam; common fine prominent yellowish brown (10YR 5.6) mottles; massive; friable; few prominent black iron and manganese coatings; very strongly acid; gradual wavy boundary.

Cg2—34 to 48 inches; light brownish gray (2.5Y 6/2) silt loam; many medium prominent reddish yellow (7.5YR 6/6) mottles; massive; friable; few prominent black iron and manganese coatings; strongly acid; diffuse wavy boundary.

Cg3—48 to 60 inches; light brownish gray (2.5Y 6/2) silt loam; many medium prominent reddish yellow (7.5YR 6/6) mottles; massive; friable; few prominent black iron and manganese coatings; strongly acid.

The thickness of the solum ranges from 10 to 30 inches. The depth to bedrock is 60 inches or more. Reaction is very strongly acid or strongly acid throughout the profile unless the soils have been limed.

The A or Ap horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 to 3. It is silt loam.

The Bg horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 or 6, and chroma of 1 or 2, or it is neutral in hue and has value of 5 or 6. It is mottled in shades of brown, gray, or olive. In many pedons it has black iron and manganese coatings. The Cg horizon has colors and textures similar to those of the Bg horizon.

Cloverlick Series

The Cloverlick series consists of deep and very deep, well drained soils on mountains. Permeability is moderate. These soils formed in stony, loamy colluvium or material weathered from sandstone and siltstone. Slopes range from 35 to 75 percent. Cloverlick soils are loamy-skeletal, mixed, mesic Umbric Dystrochrepts.

Cloverlick soils are associated on the landscape with Guyandotte, Kimper, Highsplint, and Shelocta soils. Guyandotte soils have an umbric epipedon. Highsplint and Shelocta soils have a surface layer that is lighter colored than that of the Cloverlick soils. Kimper soils are fine-loamy.

Typical pedon of Cloverlick gravelly loam, in an area of Cloverlick-Guyandotte-Highsplint complex, 35 to 75 percent slopes, very stony; on a linear, east-facing slope of 65 percent, at an elevation of 2,440 feet, in a forest of sugar maple, yellow poplar, and black locust; 3,400 feet east-southeast of the confluence of the Left and Right Forks of Cloverlick Creek; about 5 miles southeast of Cumberland, in Harlan County; Benham quadrangle; Kentucky coordinates 2,820,050 feet east and 224,200 feet north:

Oi—2 inches to 0; partially decomposed leaves, roots, and twigs.

A—0 to 6 inches; very dark gray (10YR 3/1) gravelly loam, brown (10YR 4/3) dry; moderate fine granular structure; very friable; many fine roots; about 30 percent rock fragments; very strongly acid; clear wavy boundary.

Bw1—6 to 16 inches; brown (10YR 4/3) gravelly loam, yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure; friable; common medium roots; about 20 percent rock fragments; very strongly acid; clear wavy boundary.

Bw2—16 to 22 inches; yellowish brown (10YR 5/4) gravelly loam; weak medium subangular blocky structure; friable; common medium roots; about 30 percent rock fragments; very strongly acid; clear wavy boundary.

Bw3—22 to 29 inches; yellowish brown (10YR 5/4) very gravelly loam; weak medium subangular blocky structure; friable; few fine roots; about 35 percent rock fragments; very strongly acid; clear wavy boundary.

Bw4—29 to 41 inches; yellowish brown (10YR 5/4) very gravelly loam; weak medium and coarse subangular blocky structure; friable; few fine roots; about 50 percent rock fragments; very strongly acid; clear wavy boundary.

BC—41 to 70 inches; yellowish brown (10YR 5/4) very flaggy loam; weak coarse subangular blocky structure; friable; few fine roots; about 60 percent rock fragments; very strongly acid.

The thickness of the solum ranges from 40 to more than 60 inches. The depth to bedrock ranges from 48 to more than 60 inches. The content of rock fragments, mostly channers and flagstones, ranges from 15 to 50 percent in the A horizon, from 15 to 70 percent in the Bw horizon, and from 35 to 90 percent in the BC horizon. Reaction commonly is extremely acid to strongly acid throughout the profile. In some pedons, however, the A horizon is medium acid or slightly acid.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. The fine-earth fraction is loam.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. The fine-earth fraction is silt loam, loam, or clay loam.

The BC horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. In some pedons it is mottled in shades of brown, olive, or gray. The fine-earth fraction is sandy loam, silt loam, silty clay loam, loam, or clay loam.

Some pedons have a C horizon. This horizon has colors, textures, and a content of rock fragments similar to those of the BC horizon.

Craigsville Series

The Craigsville series consists of very deep, well drained soils on flood plains. Permeability is moderately rapid in the A and B horizons and rapid in the C horizon. These soils formed in gravelly, loamy alluvium. Slopes range from 0 to 3 percent. Craigsville soils are loamy-skeletal, mixed, mesic Fluventic Dystrochrepts.

Craigsville soils are associated on the landscape with Philo and Pope soils. Philo soils are coarse-loamy and moderately well drained. Pope soils are coarse-loamy and well drained.

Typical pedon of Craigsville gravelly fine sandy loam, in an area of Craigsville-Philo complex, occasionally flooded; on a smooth slope of 1 percent in a meadow of white clover and tall fescue; 400 feet north-northeast of the confluence of Peters Branch and the Right Fork Straight Creek and 100 feet south of Kentucky Highway 221; about 3.2 miles north-northwest of Wallins Creek, in Harlan County; Wallins Creek quadrangle; Kentucky coordinates 2,675,400 feet east and 204,000 feet north:

Ap—0 to 9 inches; dark brown (10YR 4/3) gravelly fine sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; many very fine roots; about 20 percent gravel; medium acid; clear wavy boundary.

Bw1—9 to 20 inches; yellowish brown (10YR 5/4) gravelly fine sandy loam; weak fine subangular blocky structure; very friable; common fine roots; about 30 percent rock fragments; few prominent black (10YR 2/1) manganese coatings on rock fragments; strongly acid; clear wavy boundary.

2C1—20 to 43 inches; yellowish brown (10YR 5/4) extremely gravelly loamy fine sand; single grained with some weak fine granular structure; very friable; few fine roots; about 65 percent rock fragments; few prominent black (10YR 2/1) manganese coatings on rock fragments; strongly acid; diffuse wavy boundary.

2C2—43 to 60 inches; yellowish brown (10YR 5/4) extremely gravelly loamy fine sand; single grained; loose; few fine roots; about 65 percent rock fragments; few prominent black (10YR 2/1) manganese coatings on rock fragments; strongly acid.

The thickness of the solum ranges from 12 to 24 inches. The depth to bedrock is 60 inches or more. Rock fragments, mostly pebbles and cobbles, make up 5 to 50 percent of the solum and 35 to 90 percent of the C horizon. Reaction is very strongly acid or strongly acid unless the soils have been limed.

The A or Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4. The fine-earth fraction is fine sandy loam.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. The fine-earth fraction is sandy loam or fine sandy loam.

The 2C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. The fine-earth fraction is loamy sand, loamy fine sand, or sand. In some pedons this horizon has thin layers with less than 35 percent rock fragments.

Crossville Series

The Crossville series consists of moderately deep, well drained soils on mountain crests. Permeability is moderate. These soils formed in loamy material weathered from sandstone. Slopes range from 3 to 20 percent. Crossville soils are fine-loamy, siliceous, mesic Umbric Dystrochrepts.

Crossville soils are associated on the landscape with Alticrest, Totz, Helechawa, Jefferson, and Varilla soils. Alticrest soils have a surface layer that is lighter colored than that of the Crossville soils and contain less clay in the subsoil. Helechawa, Jefferson, and Varilla soils are deep or very deep. Totz soils are shallow.

Typical pedon of Crossville loam, 3 to 12 percent slopes; on a 5 percent convex ridge crest in a field of fescue, orchardgrass, and timothy hay 400 feet northwest of a house in the Hensley Settlement area of the Cumberland Gap National Historical Park; about 2.4 miles south-southwest of Cubage, in Bell County; Varilla quadrangle; Kentucky coordinates 2,649,300 feet east and 130,200 feet north:

Ap—0 to 7 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate medium granular structure; friable; many fine roots; about 1 percent gravel; strongly acid; abrupt wavy boundary.

BA—7 to 11 inches; dark yellowish brown (10YR 4/4) loam; moderate very fine subangular blocky structure; friable; common fine roots; about 1 percent gravel; strongly acid; gradual wavy boundary.

Bw—11 to 24 inches; yellowish brown (10YR 5/6) loam; moderate medium subangular blocky structure; friable; common fine roots; about 1 percent gravel; very strongly acid; abrupt wavy boundary.

Cr—24 to 37 inches; sandstone bedrock; weakly cemented.

R—37 inches; sandstone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. Rock fragments, commonly gravel, make up 0 to 15 percent of the solum. Reaction is very strongly acid or strongly acid throughout the profile unless the soils have been limed.

The A or Ap horizon has hue of 10YR, value of 3, and chroma or 2 or 3. It is loam.

The BA horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam, loam, or sandy loam. The Bw horizon has colors and textures similar to those of the BA horizon.

Some pedons have a C horizon. This horizon has hue of 7.5YR or 10YR, value of 5, and chroma of 4 to 6. The fine-earth fraction is sandy loam or loamy sand. The content of rock fragments ranges from 2 to 30 percent.

Cutshin Series

The Cutshin series consists of deep and very deep, well drained soils on mountains. Permeability is moderate. These soils formed in loamy colluvium derived from sandstone, siltstone, and shale. Slopes range from 20 to 55 percent. Cutshin soils are fine-loamy, mixed, mesic Typic Haplumbrepts.

Cutshin soils are associated on the landscape with Kimper and Shelocta soils. Kimper and Shelocta soils have an ochric epipedon.

Typical pedon of Cutshin silt loam (fig. 17), in an area of Shelocta-Kimper-Cutshin complex, 20 to 55 percent slopes, very stony; on a smooth, north-facing slope of 50 percent, at an elevation of 3,680 feet, in a forest of sugar maple, black cherry, and yellow poplar; 6,000 feet southeast of the confluence of the Left and Right Forks of Cloverlick Creek; about 5 miles southeast of Cumberland, in Harlan County; Benham quadrangle; Kentucky coordinates 2,824,300 feet east and 224,100 feet north:

Oi—2 inches to 0; partially decomposed leaves, roots, and twigs.

A—0 to 9 inches; very dark gray (10YR 3/1) silt loam, dark brown (10YR 4/3) dry; moderate fine granular structure; very friable; many fine roots; about 5 percent rock fragments; very strongly acid; gradual wavy boundary.

AB—9 to 17 inches; dark brown (10YR 3/3) silt loam, yellowish brown (10YR 5/4) dry; moderate medium granular structure; friable; many medium roots; about 5 percent rock fragments; very strongly acid; gradual irregular boundary.

Bw1—17 to 24 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; few medium roots; dark brown (10YR 4/3) soil material in root channels; about 10 percent rock fragments; very strongly acid; gradual wavy boundary.

Bw2—24 to 43 inches; yellowish brown (10YR 5/6) gravelly loam; moderate medium subangular blocky structure; friable; few medium roots; common faint yellowish brown silt coatings on faces of peds; about 20 percent rock fragments; very strongly acid; clear wavy boundary.

BC—43 to 60 inches; yellowish brown (10YR 5/6) very gravelly loam; weak medium subangular blocky structure; friable; few fine roots; about 35 percent rock fragments; very strongly acid.

The thickness of the solum and the depth to bedrock range from 40 to more than 70 inches. The content of rock fragments, mostly channers and flagstones, is 5 to 35 percent throughout the profile. Reaction is extremely acid to slightly acid in the A horizon and very strongly acid or strongly acid in the Bw horizon.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. The fine-earth fraction is silt loam. The AB horizon has colors and textures similar to those of the A horizon.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. The fine-earth fraction is silt loam or loam.

The BC horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. The fine-earth fraction is loam or sandy loam.

Some pedons have a C horizon. This horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. The fine-earth fraction is sandy loam or loam. Reaction is very strongly acid or strongly acid.

Fairpoint Series

The Fairpoint series consists of very deep, well drained soils on mountains. Permeability is moderately slow. These soils formed in stony, loamy, nonacid regolith in areas that have been surface mined for coal or in other highly disturbed areas. Slopes range from 2 to 70 percent. Fairpoint soils are loamy-skeletal, mixed, nonacid, mesic Typic Udorthents.

Fairpoint soils are associated on the landscape with Bethesda soils. Bethesda soils are acid.

Typical pedon of Fairpoint channery silt loam (fig. 18), in an area of Fairpoint and Bethesda soils, 2 to 20 percent slopes; on a linear slope of 2 percent in a pasture of tall fescue; 5,500 feet northeast of the confluence of Cranes Creek and Yellow Creek, 500 feet north of an apple orchard, and along a road; about 0.7 mile north-northeast of Colmar, in Bell County; Middlesboro North quadrangle; Kentucky coordinates 2,617,900 feet east and 131,000 north:

Ap—0 to 3 inches; dark olive gray (5Y 3/2) channery silt loam; moderate fine granular structure; friable; many very fine roots; about 30 percent channers; neutral; clear smooth boundary.

AC—3 to 10 inches; dark olive gray (5Y 3/2) extremely channery silt loam; moderate medium granular structure; friable; many very fine roots; about 65 percent channers; neutral; gradual smooth boundary.

C1—10 to 26 inches; dark olive gray (5Y 3/2) extremely channery silt loam; massive; friable; common very fine roots; about 75 percent channers; neutral; gradual smooth boundary.

C2—26 to 38 inches; olive gray (5Y 4/2) extremely channery silt loam; massive; friable; few very fine roots; about 80 percent channers; neutral; diffuse smooth boundary.

C3—38 to 60 inches; olive gray (5Y 4/2) extremely channery silt loam; massive; friable; very fine roots; about 80 percent channers; neutral.

The depth to bedrock is 60 inches or more. Rock fragments, mostly channers and flagstones, make up 15 to 60 percent of the A horizon and 35 to 80 percent of the AC and C horizons. Reaction is medium acid to neutral throughout the profile.

The Ap horizon has hue of 7.5YR, 10YR, 2.5Y, or 5Y, value of 3 to 6, and chroma of 1 to 6, or it is neutral in hue and has value of 3 to 6. The fine-earth fraction is silt loam. The AC horizon has colors and textures similar to those of the Ap horizon.

The C horizon has hue of 7.5YR, 10YR, 2.5Y, or 5Y, value of 3 to 6, and chroma of 1 to 8, or it is neutral in hue and has value of 3 to 6. The fine-earth fraction is silt loam, silty clay loam, loam, or clay loam.

Gilpin Series

The Gilpin series consists of moderately deep, well drained soils on hills and mountains. Permeability is moderate. These soils formed in loamy material weathered from shale, siltstone, and sandstone. Slopes range from 3 to 55 percent. Gilpin soils are fine-loamy, mixed, mesic Typic Hapludults.

Gilpin soils are associated on the landscape with Sequoia and Shelocta soils. Shelocta soils are deep or very deep. Sequoia soils are clayey.

Typical pedon of Gilpin silt loam, in a small wooded area of Gilpin-Shelocta silt loams, 12 to 20 percent slopes; on a south-facing slope of 15 percent; 1,500 feet east of the Tucker-Guthrie Memorial Airport hanger building and 20 feet south of the county road; about 0.9 mile north of Loyall, in Harlan County; Harlan quadrangle; Kentucky coordinates 2,701,050 feet east and 200,200 feet north:

A—0 to 2 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate very fine granular structure; friable; many fine roots; about 10 percent channers; very strongly acid; abrupt wavy boundary.

E—2 to 6 inches; brownish yellow (10YR 6/6) silt loam, very pale brown (10YR 7/4) dry; weak fine granular structure; friable; many fine roots; about 10 percent channers; very strongly acid; abrupt wavy boundary.

Bt1—6 to 15 inches; strong brown (7.5YR 5/6) channery silty clay loam; moderate medium subangular blocky structure; firm; common distinct brown (7.5YR 5/4) clay films on faces of peds; common fine roots; about 15 percent channers; very strongly acid; gradual wavy boundary.

Bt2—15 to 28 inches; brownish yellow (10YR 6/6) channery silty clay loam; weak medium subangular blocky structure; firm; few distinct brown (7.5YR 5/4) and yellowish brown (10YR 5/8) clay films on faces of peds; few fine roots; about 15 percent channers; very strongly acid; clear wavy boundary.

R—28 inches; siltstone; weakly cemented.

The thickness of the solum ranges from 18 to 36 inches. The depth to bedrock ranges from 20 to 40 inches. Rock fragments, commonly channers, make up about 5 to 35 percent of the solum. Most are thin, flat pieces of shale, siltstone, and sandstone. Reaction is very strongly acid or strongly acid throughout the profile unless the soils have been limed.

The A or Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. The fine-earth fraction is loam or silt loam.

The E horizon has hue of 10YR and value and chroma of 4 to 6. The fine-earth fraction is loam or silt loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 8. The fine-earth fraction is silt loam, loam, or silty clay loam.

Some pedons have a C horizon. This horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 or 5, and chroma of 3 to 6. The fine-earth fraction is silt loam, loam, or silty clay loam. The content of rock fragments is 30 to 90 percent.

Guyandotte Series

The Guyandotte series consists of very deep, well drained soils on mountains. Permeability is moderate. These soils formed in stony, loamy colluvium or material weathered from sandstone, siltstone, and shale. Slopes range from 35 to 75 percent. Guyandotte soils are loamy-skeletal, mixed, mesic Typic Haplumbrepts.

Guyandotte soils are associated on the landscape with Cloverlick, Cutshin, and Highsplint soils. Cutshin soils are fine-loamy. Highsplint and Cloverlick soils have an ochric epipedon.

Typical pedon of Guyandotte very channery loam (fig. 19), in an area of Cloverlick-Guyandotte-Highsplint complex, 35 to 75 percent slopes, very stony; on a northeast-facing slope of 58 percent, at an elevation of 2,500 feet, in a stand of mixed hardwoods; 3,450 feet south of the confluence of the Left and Right Forks of Cloverlick Creek; about 5 miles southeast of Cumberland, in Harlan County; Benham quadrangle; Kentucky coordinates 2,819,900 east and 224,100 north:

Oi—2 inches to 0; partially decomposed leaves, roots, and twigs; abrupt wavy boundary.

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) very channery loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; very friable; many very fine roots; about 50 percent channers; strongly acid; gradual wavy boundary.

A2—7 to 17 inches; dark brown (10YR 3/3) very channery loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; friable; many fine roots; about 50 percent channers; very strongly acid; clear wavy boundary.

Bw1—17 to 40 inches; dark yellowish brown (10YR 4/4) very channery loam; moderate fine subangular blocky structure; friable; common fine roots; about 50 percent channers; strongly acid; diffuse wavy boundary.

Bw2—40 to 61 inches; yellowish brown (10YR 5/4) very channery loam; moderate very fine subangular blocky structure; friable; few fine roots; about 60 percent channers; very strongly acid.

The thickness of the solum ranges from 50 to more than 70 inches. The depth to bedrock is 72 inches or more. Rock fragments, mostly channers and flagstones, make up 35 to 70 percent of the solum. Reaction is extremely acid to slightly acid in the A horizon and very strongly acid to medium acid in the B horizon.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. The fine-earth fraction is loam or silt loam.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. The fine-earth fraction is silt loam or loam.

Some pedons have a C horizon. This horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. The fine-earth fraction is sandy loam or loam. The content of rock fragments ranges from 35 to 70 percent. Reaction is very strongly acid to medium acid.

Helechawa Series

The Helechawa series consists of deep and very deep, somewhat excessively drained soils on mountains. Permeability is moderately rapid. These soils formed in loamy colluvium or material weathered from sandstone and siltstone. Slopes range from 20 to 75 percent. Helechawa soils are coarse-loamy, siliceous, mesic Typic Dystrochrepts.

Helechawa soils are associated on the landscape with Alticrest, Jefferson, Totz, and Varilla soils. Alticrest soils are moderately deep. Totz soils are shallow. Jefferson soils are fine-loamy. Varilla soils are loamy-skeletal.

Typical pedon of Helechawa sandy loam (fig. 20), in an area of Alticrest-Totz-Helechawa complex, rocky, 20 to 55 percent slopes; on a southeast-facing, linear slope of 40 percent, at an elevation of 2,740 feet, in a forest of scarlet oak, chestnut oak, and red maple; 1,100 feet southeast of Jacks Gap and 650 feet south-southeast of the Little Shepherd Trail; about 1.5 miles north of Nolansburg, in Harlan County; Nolansburg quadrangle; Kentucky coordinates 2,756,250 feet east and 233,600 feet north:

Oi—2 inches to 0; partially decomposed leaves, roots, and twigs; abrupt wavy boundary.

A—0 to 5 inches; very dark grayish brown (10YR 3/2) sandy loam; moderate very fine granular structure parting to weak fine granular; very friable; many fine roots; about 5 percent gravel and 2 percent cobbles; extremely acid; abrupt wavy boundary.

BA—5 to 10 inches; yellowish brown (10YR 5/6) sandy loam; weak medium subangular blocky structure; very friable; common medium roots; about 5 percent gravel and 2 percent cobbles; very strongly acid; gradual wavy boundary.

Bw1—10 to 20 inches; yellowish brown (10YR 5/6) sandy loam; weak coarse subangular blocky structure parting to moderate medium subangular blocky; very friable; few medium roots; about 5 percent gravel and 2 percent cobbles; very strongly acid; clear wavy boundary.

Bw2—20 to 38 inches; yellowish brown (10YR 5/6) sandy loam; weak coarse subangular blocky structure parting to moderate medium subangular blocky; friable; few medium roots; about 5 percent gravel and 2 percent cobbles; extremely acid; clear wavy boundary.

BC—38 to 49 inches; yellowish brown (10YR 5/6) sandy loam; weak coarse subangular blocky structure parting to moderate medium subangular blocky; friable; few medium roots; few faint yellowish brown (10YR 5/6) clay bridges between sand grains; about 3 percent gravel and 2 percent cobbles; very strongly acid; clear wavy boundary.

C—49 to 63 inches; strong brown (7.5YR 5/6) loamy sand; massive; very friable; few fine roots; about 3 percent gravel and 2 percent weakly cemented cobbles; extremely acid; clear wavy boundary.

R—63 inches; sandstone bedrock.

The thickness of the solum ranges from 30 to more than 60 inches. The depth to bedrock ranges from 40 to more than 60 inches. Rock fragments, commonly gravel, make up 0 to 35 percent of the solum and 5 to 80 percent of the C horizon. Reaction generally is extremely acid to strongly acid throughout the profile. In some pedons, however, the A horizon is medium acid or slightly acid.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. The fine-earth fraction is sandy loam or fine sandy loam.

The BA horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. The fine-earth fraction is sandy loam, fine sandy loam, or loam.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 8. The fine-earth fraction is sandy loam, loam, or fine sandy loam. The BC horizon has colors and fine-earth textures similar to those of the Bw horizon.

The C horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 to 6. The fine-earth fraction is sand, loamy sand, or sandy loam.

Highsplint Series

The Highsplint series consists of deep and very deep, well drained soils on mountains. Permeability is moderate or moderately rapid. These soils formed in stony, loamy colluvium or material weathered from sandstone and siltstone (fig. 21). Slopes range from 5 to 75 percent. Highsplint soils are loamy-skeletal, mixed, mesic Typic Dystrochrepts.

Highsplint soils are associated on the landscape with Cloverlick, Shelocta, Kimper, and Guyandotte soils. Cloverlick soils have a dark surface layer. Shelocta and Kimper soils are fine-loamy. Guyandotte soils have an umbric epipedon.

Typical pedon of Highsplint very channery silt loam, in an area of Highsplint-Cloverlick-Guyandotte complex, 35 to 75 percent slopes, very stony; on a smooth, south-facing slope of 55 percent, at an elevation of 2,100 feet, in a forest of American beech, white oak, and chestnut oak; 1,300 feet northeast of the confluence of the Left and Right Forks of Cloverlick Creek; about 5.5 miles southeast of Cumberland, in Harlan County; Benham quadrangle; Kentucky coordinates 2,820,000 feet east and 228,100 feet north:

Oi—2 inches to 0; partially decomposed leaves, twigs, and roots.

A—0 to 4 inches; dark brown (10YR 4/3) very channery silt loam; moderate medium granular structure; very friable; many fine roots; about 50 percent rock fragments (40 percent channers and 10 percent flagstones); very strongly acid; clear wavy boundary.

BA—4 to 11 inches; yellowish brown (10YR 5/4) very channery silt loam; weak fine subangular blocky structure; friable; common medium roots; about 50 percent rock fragments (40 percent channers and 10 percent flagstones); very strongly acid; gradual wavy boundary.

Bw1—11 to 28 inches; yellowish brown (10YR 5/6) very channery silty clay loam; moderate medium subangular blocky structure; friable; few medium roots; about 50 percent rock fragments (40 percent channers and 10 percent flagstones); very strongly acid; diffuse wavy boundary.

Bw2—28 to 48 inches; yellowish brown (10YR 5/6) very channery loam; moderate medium subangular blocky structure; friable; few fine roots; about 50 percent rock fragments (40 percent channers and 10 percent flagstones); very strongly acid; gradual wavy boundary.

BC—48 to 60 inches; yellowish brown (10YR 5/6) very channery loam; few fine prominent light gray (10YR 7/1) and few fine distinct yellowish red (5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; few distinct clay films on faces of peds; about 20 percent of horizon is compact and brittle; about 50 percent rock fragments (40 percent channers and 10 percent flagstones); very strongly acid.

The thickness of the solum ranges from 40 to more than 60 inches. The depth to bedrock ranges from 48 to more than 60 inches. The content of rock fragments, mostly channers and flagstones, commonly is 35 to 90 percent throughout the profile. In some pedons, however, it is 15 to 35 percent in the upper 24 inches. Reaction is extremely acid to slightly acid in the A and BA horizons and extremely acid to strongly acid in the Bw horizon.

The A horizon has hue of 10YR and generally has value of 4 or 5 and chroma of 2 to 4. Some pedons have a thin A horizon with value and chroma of 2 or 3. The fine-earth fraction is silt loam or loam.

The BA horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. The fine-earth fraction is silt loam, loam, or silty clay loam.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 4 to 8. In some pedons it is mottled in shades of brown, olive, or gray below a depth of 24 inches. The fine-earth fraction is silt loam, loam, silty clay loam, or clay loam.

Some pedons have a C horizon. This horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. In some pedons it is mottled in shades of brown, olive, or gray. The fine-earth fraction is sandy loam, fine sandy loam, silt loam, silty clay loam, loam, or clay loam. Reaction is extremely acid to strongly acid.

Jefferson Series

The Jefferson series consists of very deep, well drained soils on mountains. Permeability is moderately rapid or moderate. These soils formed in loamy

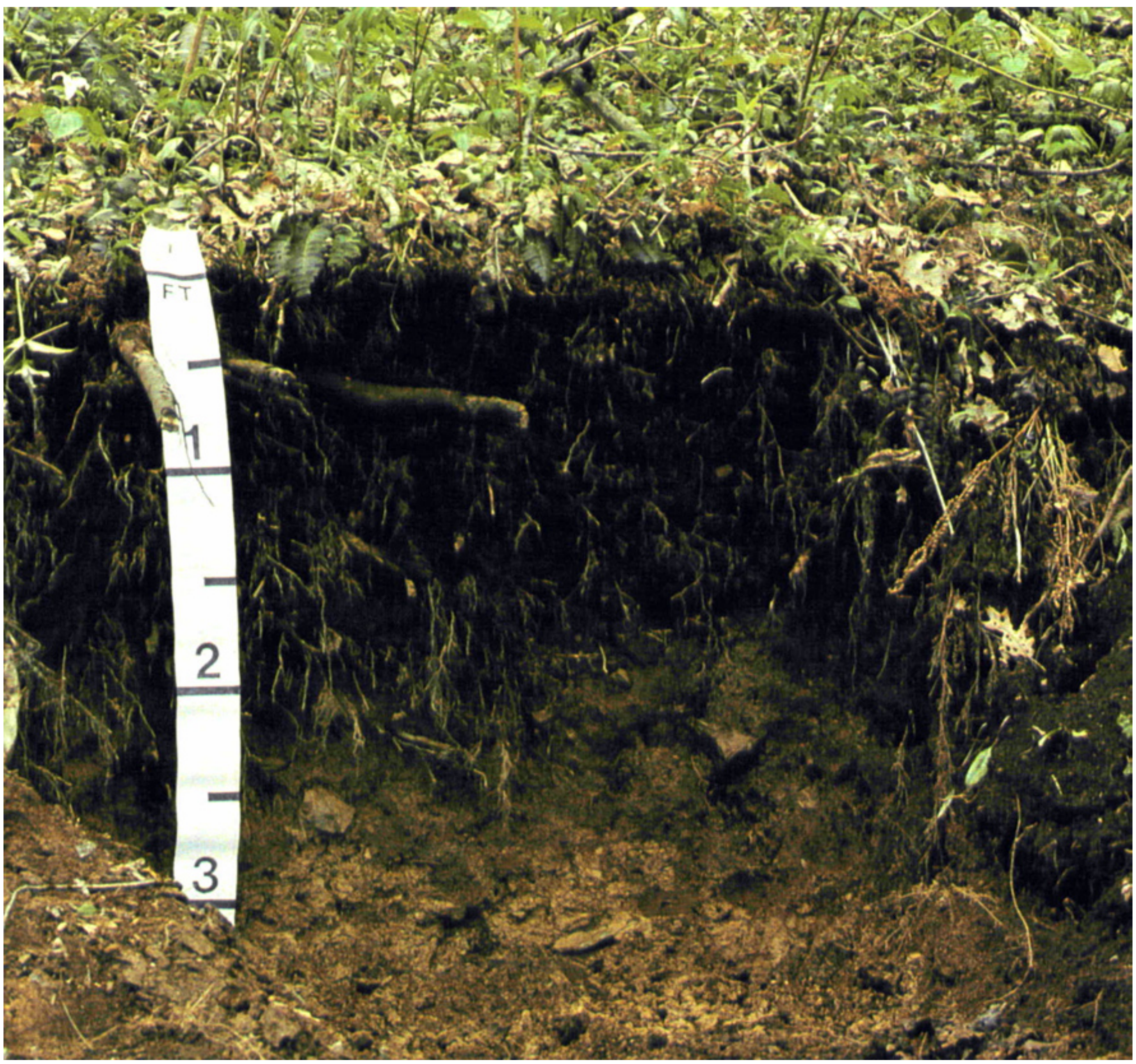

Figure 17.—Typical profile of a Cutshin silt loam. The umbric epipedon extends to a depth of 17 inches.

Figure 18.—Typical profile of a Fairpoint channery silt loam. This soil has a high content of rock fragments.

Figure 19.—Typical profile of a Guyandotte very channery loam. Below a depth of 29 inches, rock fragments make up 50 percent or more of the volume.

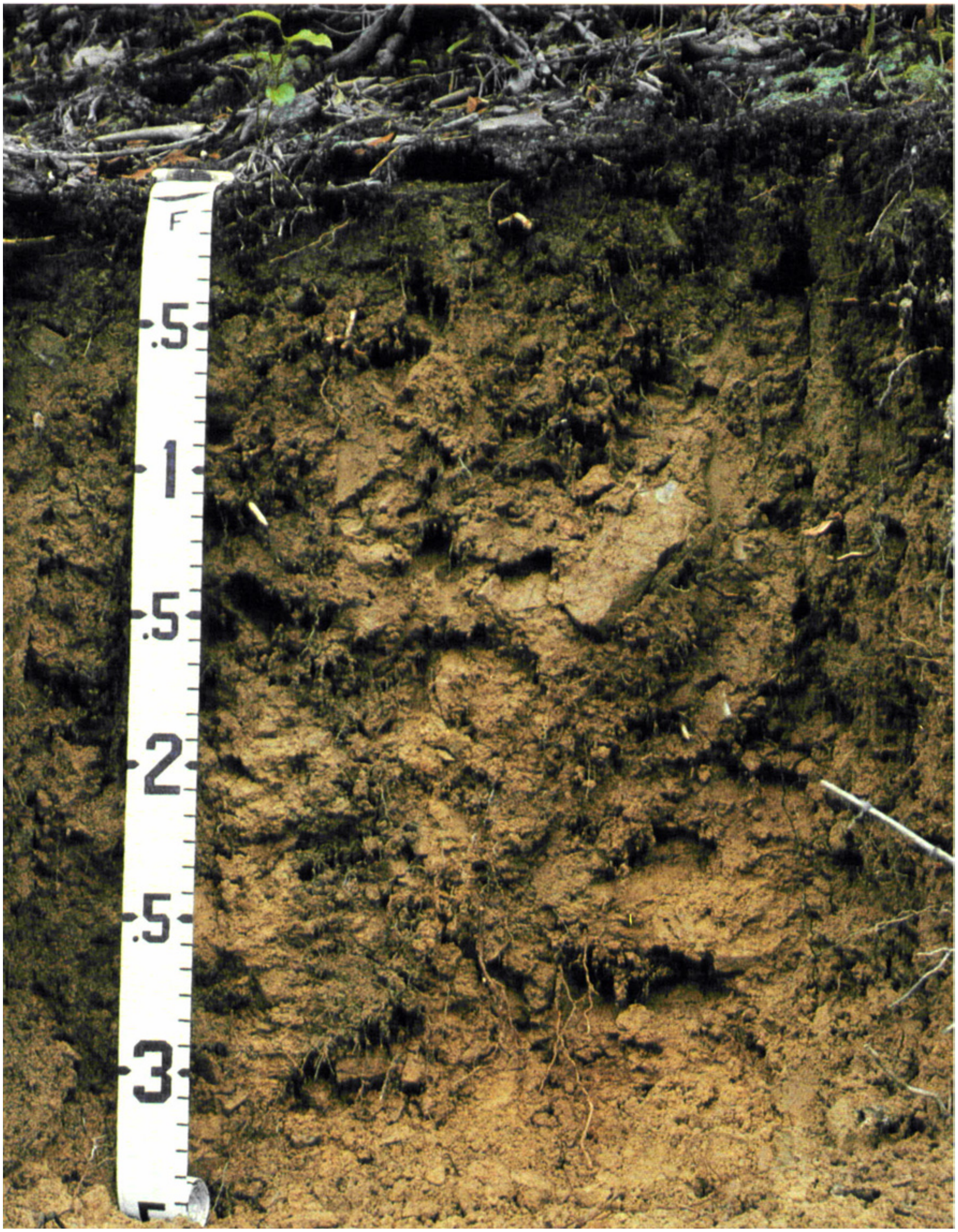

Figure 20.—Typical profile of a Helechawa sandy loam. This soil has a thin A horizon under acid-forming vegetation, such as mountain laurel and sourwood. Depth is marked in feet.

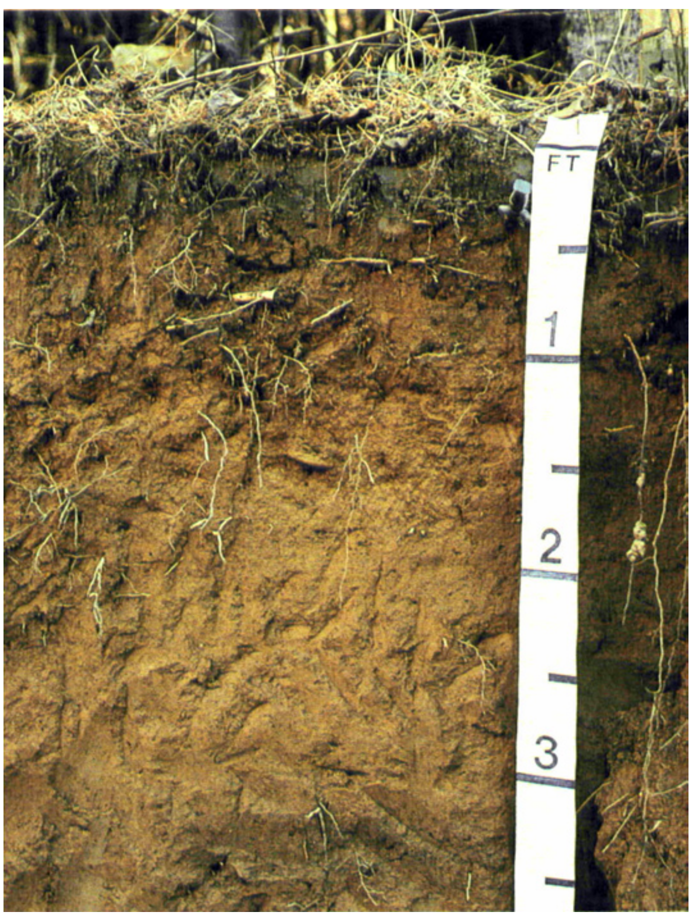

Figure 21.—Profile of a Highsplint very channery silt loam. Rock fragments of various sizes are common in this colluvial soil.

Figure 22.—Typical profile of Pope fine sandy loam, occasionally flooded. Depth is marked in feet.

colluvium derived from sandstone and siltstone. Slopes range from 12 to 75 percent. Jefferson soils are fine-loamy, siliceous, mesic Typic Hapludults.

Jefferson soils are associated on the landscape with Alticrest, Helechawa, and Varilla soils. Alticrest and Helechawa soils are coarse-loamy. Varilla soils are loamy-skeletal.

Typical pedon of Jefferson gravelly silt loam, 12 to 20 percent slopes; on a concave, south-facing slope of 20 percent, at an elevation of 1,320 feet, in an old field; 20 feet west of Sergent Cemetery and 100 feet north of Kentucky Highway 522; about 1.4 miles northeast of Rosspoint, in Harlan County; Bledsoe quadrangle; Kentucky coordinates 2,725,800 feet east and 214,100 feet north:

A—0 to 3 inches; dark grayish brown (10YR 4/2) gravelly silt loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; many very fine roots; about 20 percent rock fragments; strongly acid; clear wavy boundary.

E—3 to 9 inches; yellowish brown (10YR 5/4) gravelly silt loam; weak fine granular structure; friable; common fine roots; about 20 percent rock fragments; strongly acid; clear wavy boundary.

BE—9 to 23 inches; yellowish brown (10YR 5/6) silt loam; weak very fine subangular blocky structure; friable; common medium roots; about 10 percent rock fragments; very strongly acid; gradual wavy boundary.

Bt—23 to 40 inches; yellowish brown (10YR 5/6) gravelly loam; moderate fine subangular blocky structure; friable; few fine roots; many distinct strong brown (7.5YR 5/6) clay films on faces of peds; about 25 percent rock fragments; strongly acid; gradual wavy boundary.

BC—40 to 75 inches; yellowish brown (10YR 5/6) very gravelly loam; many medium distinct light yellowish brown (10YR 6/4) mottles; weak medium subangular blocky structure; friable; very few fine roots; few distinct brown (7.5YR 4/4) clay films on faces of peds; about 40 percent rock fragments; strongly acid.

The solum is more than 40 inches thick. The depth to bedrock is 60 inches or more. The content of rock fragments, commonly gravel, is 5 to 35 percent to a depth of 40 inches and 20 to 80 percent below that depth. Reaction commonly is very strongly acid or strongly acid throughout the profile unless the soils have been limed. In some pedons the A horizon is medium acid to neutral.

The A or Ap horizon has hue of 10YR and generally has value of 4 or 5 and chroma of 3 or 4. Some pedons have a thin A horizon with value of 3 and chroma of 2 or 3. The fine-earth fraction is silt loam or loam.

The E horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. The fine-earth fraction is sandy loam, fine sandy loam, silt loam, or loam.

The BE horizon has hue of 10YR, value of 4 to 6, and chroma of 4 to 8. The fine-earth fraction is sandy loam, loam, or silt loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 4 to 8. The fine-earth fraction is sandy loam or loam. The BC horizon has colors and textures similar to those of the Bt horizon.

Some pedons have a C horizon. This horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 to 6. It is mottled in shades of brown, red, or gray. The fine-earth fraction is sandy loam, fine sandy loam, sandy clay loam, or clay loam.

Some pedons have a 2C horizon below a depth of about 50 inches. This horizon formed in shaly material and has a higher content of clay than the rest of the profile.

Kimper Series

The Kimper series consists of deep and very deep, well drained soils on mountainsides, most commonly on north- or east-facing slopes. Permeability is moderate. These soils formed in loamy colluvium or material weathered from sandstone, siltstone, and shale. Slopes range from 5 to 75 percent. Kimper soils are fine-loamy, mixed, mesic Umbric Dystrochrepts.

Kimper soils are associated on the landscape with Cloverlick, Cutshin, and Shelocta soils. Cloverlick soils are loamy-skeletal. Cutshin soils have an umbric epipedon. Shelocta soils have a light colored surface layer and have an argillic horizon.

Typical pedon of Kimper gravelly silt loam, in an area of Shelocta-Kimper-Cutshin complex, 20 to 55 percent slopes, very stony; on a convex, southwest-facing slope of 30 percent, at an elevation of 3,680 feet, in a scrub forest of chestnut oak and American chestnut; 6,450 feet southeast of the confluence of the Left and Right Forks of Cloverlick Creek; about 5.5 miles southeast of Cumberland, in Harlan County; Benham quadrangle; Kentucky coordinates 2,824,350 feet east and 223,350 feet north:

Oi—1 inch to 0; partially decomposed leaves, roots, and twigs; abrupt wavy boundary.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) gravelly silty clay loam, brown (10YR 5/3) dry; moderate fine granular structure; very friable; many very fine roots; about 25 percent rock fragments; very strongly acid; abrupt wavy boundary.

AB—2 to 7 inches; dark yellowish brown (10YR 4/4) gravelly silt loam, yellowish brown (10YR 5/4) dry; moderate fine granular structure; friable; common medium roots; about 25 percent rock fragments; very strongly acid; clear wavy boundary.

Bw1—7 to 18 inches; yellowish brown (10YR 5/4) gravelly silty clay loam; moderate fine subangular blocky structure; friable; common medium roots; about 10 percent dark brown (10YR 4/3) soil material in root channels; about 25 percent rock fragments; very strongly acid; gradual wavy boundary.

Bw2—18 to 34 inches; yellowish brown (10YR 5/6) gravelly silty clay loam; moderate medium subangular blocky structure; friable; few medium roots; about 5 percent brown (10YR 5/3) soil material in root channels; common faint yellowish brown silt coatings on faces of peds; about 30 percent rock fragments; very strongly acid; gradual wavy boundary.

BC—34 to 48 inches; yellowish brown (10YR 5/6) very gravelly silt loam; common medium distinct strong brown (7.5YR 5/8) and few fine distinct light yellowish brown (10YR 6/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; common faint yellowish brown silt coatings on faces of peds; about 40 percent rock fragments; very strongly acid; gradual wavy boundary.

C—48 to 62 inches; yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) channery silt loam; massive with horizontal plates that are remnants of the shale bedrock structure; firm; few fine roots; about 30 percent rock fragments, of which 5 percent are soft masses of black (N 2/0) carbonaceous material; very strongly acid; gradual wavy boundary.

R—62 inches; shale bedrock.

The thickness of the solum ranges from 40 to more than 60 inches. The depth to bedrock is 48 inches or more. Rock fragments, commonly channers, make up about 5 to 35 percent of the solum, but they make up as much as 60 percent of individual horizons. Reaction is extremely acid to slightly acid in the A and AB horizons and very strongly acid to medium acid in the Bw, BC, and C horizons.

The A horizon has hue of 7.5YR or 10YR, value of 2 to 4, and chroma or 1 to 4. When mixed to a depth of 7 inches, it has value of 2 or 3 or has value of 5 or less when dry. The fine-earth fraction is silt loam or silty clay loam. The AB horizon has colors and textures similar to those of the A horizon.

The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. In some pedons it is mottled in shades of yellow or red. The fine-earth fraction is loam, silt loam, clay loam, or silty clay loam. The BC horizon has colors and textures similar to those of the Bw horizon.

The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6, and chroma of 2 to 8. The fine-earth fraction is loam, sandy loam, silt loam, or silty clay loam.

Philo Series

The Philo series consists of deep and very deep, moderately well drained soils on flood plains. Permeability is moderate. These soils formed in loamy alluvium. Slopes range from 0 to 2 percent. Philo soils are coarse-loamy, mixed, mesic Fluvaquentic Dystrochrepts.

Philo soils are associated on the landscape with Shelbiana, Pope, and Craigsville soils. Shelbiana soils have an umbric epipedon. Pope soils are well drained. Craigsville soils are loamy-skeletal and somewhat excessively drained.

Typical pedon of Philo fine sandy loam, occasionally flooded; on a slightly undulating slope of 1 percent in a meadow of tall fescue, orchardgrass, and red clover; 2,200 feet east along State Highway 1137 from the confluence of Little Creek and Crummies Creek and 100 feet north of the highway; about 1.8 miles northeast of Cawood, in Harlan County; Evarts quadrangle; Kentucky coordinates 2,745,750 feet east and 179,050 feet north:

Ap—0 to 9 inches; brown (10YR 4/3) fine sandy loam; moderate fine granular structure; friable; many fine roots; about 5 percent gravel; strongly acid; abrupt wavy boundary.

Bw1—9 to 16 inches; yellowish brown (10YR 5/4) fine sandy loam; moderate fine subangular blocky structure; friable; common fine roots; about 5 percent gravel; strongly acid; clear smooth boundary.

Bw2—16 to 24 inches; yellowish brown (10YR 5/4) fine sandy loam; common medium distinct light brownish gray (10YR 6/2) and common medium distinct brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; friable; common fine roots; about 5 percent gravel; strongly acid; clear smooth boundary.

Bw3—24 to 37 inches; yellowish brown (10YR 5/4) fine sandy loam; common medium distinct light brownish gray (10YR 6/2) and common medium distinct brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine roots; about 10 percent gravel; strongly acid; clear wavy boundary.

2C1—37 to 45 inches; yellowish brown (10YR 5/4) extremely gravelly fine sandy loam; common coarse distinct light brownish gray (10YR 6/2) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; few fine roots; about 65 percent gravel; strongly acid; clear wavy boundary.

2C2—45 to 60 inches; yellowish brown (10YR 5/4) loamy fine sand; common coarse distinct strong brown (7.5YR 4/6) and common medium distinct light brownish gray (10YR 6/2) mottles; single grained; loose; few fine roots; about 8 percent gravel; strongly acid.

The thickness of the solum ranges from 20 to 48 inches. The depth to bedrock is 48 inches or more. Rock fragments, mostly gravel, make up 0 to 20 percent of the solum and 0 to more than 65 percent of the 2C horizon. Reaction is very strongly acid to medium acid throughout the profile unless the soils have been limed.

The A or Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The fine-earth fraction is fine sandy loam.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. It is mottled in shades of brown or gray. The fine-earth fraction is sandy loam, loam, silt loam, or fine sandy loam.

The 2C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6, and chroma of 1 to 6, or it is neutral in hue and has value of 4 to 6. In most pedons it is mottled in shades of brown, red, or gray. The fine-earth fraction is silt loam, loam, fine sandy loam, sandy loam, loamy fine sand, loamy sand, or sand.

Pope Series

The Pope series consists of very deep, well drained soils on flood plains. Permeability is moderately rapid. These soils formed in loamy alluvium. Slopes range from 0 to 2 percent. Pope soils are coarse-loamy, mixed, mesic Fluventic Dystrochrepts.

Pope soils are associated on the landscape with Philo and Craigsville soils. Philo soils are moderately well drained. Craigsville soils are loamy-skeletal and somewhat excessively drained.

Typical pedon of Pope fine sandy loam, occasionally flooded (fig. 22); on a smooth slope of 1 percent in an old field planted to eastern white pine; 550 feet west of a railroad bridge over the Clover Fork of the Cumberland River and on the right bank; about 0.5 mile west of Louellen, in Harlan County; Louellen quadrangle; Kentucky coordinates 2,774,300 feet east and 222,100 feet north:

A—0 to 4 inches; brown (10YR 4/3) fine sandy loam; moderate fine granular structure; very friable; common fine roots; less than 1 percent gravel; very strongly acid; abrupt wavy boundary.

BA—4 to 12 inches; yellowish brown (10YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; common fine roots; less than 1 percent gravel; very strongly acid; clear wavy boundary.

Bw—12 to 23 inches; yellowish brown (10YR 5/4) fine sandy loam; weak fine subangular blocky structure; friable; common fine roots; less than 1 percent gravel; very strongly acid; gradual wavy boundary.

BC—23 to 45 inches; yellowish brown (10YR 5/4) loamy fine sand that has thin, wavy lamellae of dark yellowish brown (10YR 4/4) fine sandy loam; weak fine subangular blocky structure; very friable; few fine roots; less than 1 percent gravel; very strongly acid; gradual wavy boundary.

C1—45 to 59 inches; dark yellowish brown (10YR 4/4) fine sandy loam; massive; very friable; few fine roots; less than 1 percent gravel; very strongly acid; abrupt wavy boundary.

2C2—59 to 62 inches; yellowish brown (10YR 4/4) extremely gravelly sand; single grained; loose; about 75 percent gravel; very strongly acid.

The thickness of the solum ranges from 30 to 50 inches. The depth to bedrock is 60 inches or more. Rock fragments, mostly gravel, make up 0 to 15 percent of the solum, 0 to 60 percent of the C horizon, and 50 to 75 percent of the 2C horizon. Reaction is very strongly acid or strongly acid unless the soils have been limed.

The A or Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is fine sandy loam.

The BA horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is fine sandy loam, sandy loam, or loam.

The Bw horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is sandy loam, loam, silt loam, or fine sandy loam.

The BC horizon has colors similar to those of the Bw horizon. It is mottled in shades of brown or gray. It is loamy sand, loamy fine sand, fine sandy loam, or sandy loam.

The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. In some pedons it is mottled in shades of gray. The fine-earth fraction is loamy sand, loamy fine sand, fine sandy loam, or sandy loam.

The 2C horizon has colors similar to those of the C horizon. The fine-earth fraction is sand, fine sand, loamy sand, loamy fine sand, sandy loam, or fine sandy loam.

Renox Series

The Renox series consists of very deep, well drained soils on mountainsides. Permeability is moderate.

These soils formed in loamy colluvium derived from sandstone, limestone, siltstone, and shale. Slopes range from 35 to 75 percent. Renox soils are fine-loamy, mixed, mesic Ultic Hapludalfs.

Renox soils are associated on the landscape with Jefferson, Kimper, and Sharondale soils. Jefferson soils have an A horizon that is thinner or lighter colored than that of the Renox soils and have low base saturation. Kimper soils have low base saturation and a cambic horizon. Sharondale soils are loamy-skeletal.

Typical pedon of Renox loam, in an area of Kimper-Renox-Sharondale complex, very rocky, 35 to 75 percent slopes; on a convex, north-facing slope of 50 percent, at an elevation of 2,400 feet, in a forest of yellow poplar, sugar maple, yellow buckeye, and northern red oak; 1,300 feet southeast of the junction of U.S. Highway 421 and Kentucky Highway 221; about 2.2 miles southeast of Bledsoe, in Harlan County; Bledsoe quadrangle; Kentucky coordinates 2,703,600 feet east and 214,300 feet north:

Oi—1 inch to 0; partially decomposed leaves, roots, and twigs; abrupt wavy boundary.

A—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 5/3) dry; moderate fine granular structure; friable; common fine roots; about 10 percent gravel; medium acid; clear wavy boundary.

BA—6 to 11 inches; brown (10YR 4/3) loam, yellowish brown (10YR 5/4) dry; moderate very fine subangular blocky structure; friable; common fine roots; about 10 percent gravel; medium acid; clear wavy boundary.

Bt1—11 to 20 inches; dark yellowish brown (10YR 4/4) loam; moderate fine subangular blocky structure; friable; few fine roots; few faint dark yellowish brown clay films on faces of peds; about 10 percent gravel; medium acid; gradual wavy boundary.

Bt2—20 to 37 inches; strong brown (7.5YR 4/6) clay loam; moderate fine subangular blocky structure; firm; few fine roots; common distinct strong brown (7.5YR 4/6) clay films on faces of peds; about 10 percent gravel; medium acid; diffuse wavy boundary.

Bt3—37 to 55 inches; strong brown (7.5YR 4/6) clay loam; moderate fine subangular blocky structure; firm; few fine roots; common distinct strong brown (7.5YR 4/6) clay films on faces of peds; about 10 percent gravel; medium acid; gradual wavy boundary.

BC—55 to 60 inches; strong brown (7.5YR 5/6) loam; weak medium subangular blocky structure; firm; few fine roots; about 10 percent gravel; medium acid.

The thickness of the solum ranges from 40 to 60 inches. The depth to bedrock is 60 inches or more. The content of rock fragments is about 5 to 35 percent in the solum and 5 to 50 percent below the solum. Reaction is medium acid to neutral throughout the profile.

The A horizon has hue of 10YR, value of 2 or 3, and chroma or 1 to 3. The BA horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. The fine-earth fraction of this horizon is loam, clay loam, or silty clay loam.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The fine-earth fraction is loam, silt loam, clay loam, or silty clay loam. The BC horizon has colors and textures similar to those of the Bt horizon.

Some pedons have a C horizon. This horizon has hue of 10YR, 7.5YR, or 2.5Y, value of 4 or 5, and chroma of 2 to 4. The fine-earth fraction is loam, silt loam, silty clay loam, or silty clay.

Sequoia Series

The Sequoia series consists of moderately deep, well drained soils on mountains. Permeability is moderately slow. These soils formed in clayey material weathered from shale and siltstone. Slopes range from 20 to 55 percent. Sequoia soils are clayey, mixed, mesic Typic Hapludults.

Sequoia soils are associated on the landscape with Gilpin and Shelocta soils. Gilpin and Shelocta soils are fine-loamy.

Typical pedon of Sequoia silt loam, in an area of Gilpin-Shelocta-Sequoia complex, 25 to 55 percent slopes, very stony; on a convex, west-facing slope of 25 percent, at an elevation of 2,000 feet, in a forest of chestnut oak, scarlet oak, and red maple; 11,200 feet north-northwest of the confluence of Lick Fork and Yellow Creek and 150 feet east-northeast of an oil well on Trace Ridge; about 2.2 miles northwest of Binghamtown, in Bell County; Middlesboro North quadrangle; Kentucky coordinates 2,589,600 feet east and 124,800 feet north:

Oi—1 inch to 0; partially decomposed leaves, roots, and twigs; abrupt smooth boundary.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; many fine roots; about 3 percent channers; very strongly acid; abrupt wavy boundary.

A2—4 to 8 inches; yellowish brown (10YR 5/4) silt loam; weak medium granular structure; friable; common fine roots; about 3 percent channers; very strongly acid; clear smooth boundary.

Bt1—8 to 18 inches; strong brown (7.5YR 5/6) silty clay;

moderate fine subangular blocky structure; firm; common fine roots; few faint strong brown clay films on faces of peds; about 8 percent channers; very strongly acid; clear smooth boundary.

Bt2—18 to 32 inches; strong brown (7.5YR 5/6) silty clay; moderate fine subangular blocky structure; firm; few fine roots; common distinct yellowish red (5YR 5/6) clay films on faces of peds; about 8 percent channers; very strongly acid.

Cr—32 to 48 inches; multicolored siltstone; weakly cemented; parts along bedding planes; few fine roots; common thin coatings of soil material along partings; gradual smooth boundary.

R—48 inches; siltstone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. Rock fragments, commonly channers, make up 0 to 10 percent of the A horizon and 5 to 25 percent of the Bt horizon. Reaction is very strongly acid or strongly acid throughout the profile.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 to 4. Some pedons have a BA horizon. This horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 4 to 8. The fine-earth fraction of this horizon is silty clay loam, silty clay, or clay.

The Bt horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 6 to 8. The fine-earth fraction is silty clay or clay.

Some pedons have a BC horizon. This horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 4 to 8. It is mottled in shades of yellow, brown, red, or gray. The fine-earth fraction is silty clay loam, silty clay, or clay.

Sharondale Series

The Sharondale series consists of very deep, well drained soils on mountainsides. Permeability is moderately rapid. These soils formed in stony, loamy colluvium derived from sandstone, siltstone, and shale. Slopes range from 35 to 75 percent. Sharondale soils are loamy-skeletal, mixed, mesic Typic Hapludolls.

Sharondale soils are associated on the landscape with Jefferson, Renox, and Kimper soils. Jefferson, Renox, and Kimper soils have an ochric epipedon and are fine-loamy.

Typical pedon of Sharondale gravelly silt loam, in an area of Kimper-Renox-Sharondale complex, very rocky, 35 to 75 percent slopes; on a northwest-facing slope of 50 percent, at an elevation of 2,160 feet, in a forest of yellow poplar, northern red oak, and American basswood; 1,200 feet northwest of the Putney lookout tower; about 0.9 mile west-southwest of Divide, in Harlan County; Nolansburg quadrangle; Kentucky coordinates 2,737,500 feet east and 226,800 feet north:

Oi—2 inches to 0; partially decomposed leaves, roots, and twigs; abrupt wavy boundary.

A—0 to 11 inches; dark brown (10YR 3/3) gravelly silt loam, brown (10YR 5/3) dry; moderate medium granular structure; very friable; common fine roots; about 20 percent gravel; neutral; gradual wavy boundary.

AB—11 to 14 inches; dark yellowish brown (10YR 4/4) gravelly silt loam, yellowish brown (10YR 5/4) dry; weak medium granular and moderate medium subangular blocky structure; friable; few fine roots; about 25 percent gravel; neutral; gradual smooth boundary.

Bw1—14 to 27 inches; yellowish brown (10YR 5/4) very channery silt loam; weak fine subangular blocky structure; friable; few fine roots; about 35 percent channers; neutral; gradual wavy boundary.

Bw2—27 to 43 inches; yellowish brown (10YR 5/6) very channery silt loam; moderate medium subangular blocky structure; friable; few fine roots; about 50 percent channers; neutral; gradual wavy boundary.

BC—43 to 60 inches; yellowish brown (10YR 5/6) very channery loam; weak medium subangular blocky structure; friable; about 55 percent rock fragments; neutral.

The thickness of the solum ranges from 40 to 80 inches. The depth to bedrock is 60 inches or more. Rock fragments, mostly channers and flagstones, make up 10 to 50 percent of the upper part of the solum and 35 to 75 percent of the lower part. Reaction is medium acid to neutral throughout the profile.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. The AB horizon has hue of 10YR, value of 3 or 4, and chroma of 3 to 6. The fine-earth fraction is loam or silt loam.

The Bw horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. The fine-earth fraction is silt loam or loam. The BC horizon has colors and textures similar to those of the Bw horizon.

Some pedons have a C horizon. This horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. The fine-earth fraction is sandy loam, loam, silt loam, or clay loam.

Shelbiana Series

The Shelbiana series consists of very deep, well drained soils on flood plains. Permeability is moderate. These soils formed in loamy alluvium. Slopes range from 0 to 2 percent. Shelbiana soils are fine-silty, mixed, mesic Typic Palehumults.

Shelbiana soils are associated on the landscape with Philo, Pope, and Allegheny soils. Allegheny soils are on terraces and have an ochric epipedon. Philo soils have an ochric epipedon and are moderately well drained. Pope soils have an ochric epipedon and are coarse-loamy.

Typical pedon of Shelbiana loam, occasionally flooded; on a smooth slope of 1 percent in a field of tall weeds; 2,050 feet northwest of a radio tower and 75 feet north of the Cumberland River; about 1.5 miles northwest of Pineville, in Bell County; Pineville quadrangle; Kentucky coordinates 2,594,500 feet east and 165,600 feet north:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 5/3) dry; moderate fine granular structure; friable; many fine roots; strongly acid; clear smooth boundary.

A—9 to 15 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 5/3) dry; moderate medium granular structure; friable; about 30 percent wormcasts; common faint very dark gray (10YR 3/1) organic coatings on peds; common fine roots; medium acid; clear wavy boundary.

Bt1—15 to 23 inches; dark brown (10YR 3/3) loam, yellowish brown (10YR 5/4) dry; moderate medium subangular blocky structure; friable; few fine roots; brown (10YR 4/3) ped interiors; about 20 percent wormcasts; few faint very dark grayish brown clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—23 to 33 inches; brown (10YR 4/3) loam; moderate medium subangular blocky structure; friable; few fine roots; few distinct very dark gray (10YR 3/1) clay films in pores; strongly acid; gradual wavy boundary.

Bt3—33 to 45 inches; yellowish brown (10YR 5/4) loam; weak coarse prismatic structure parting to moderate medium subangular blocky; friable; few fine roots; few distinct dark grayish brown (10YR 4/2) clay films in pores and along root channels; strongly acid; gradual wavy boundary.

BC—45 to 70 inches; dark yellowish brown (10YR 4/4) loam; weak coarse prismatic structure parting to weak medium subangular blocky; friable; few fine roots; few distinct dark grayish brown (10YR 4/2) clay films in pores and along root channels; very strongly acid.

The solum is 40 or more inches thick. The depth to bedrock is 60 inches or more. The content of gravel ranges from 0 to 5 percent throughout the profile. The soils are very strongly acid to medium acid throughout unless they have been limed.

The A or Ap horizon has hue of 10YR, value of 3, and chroma of 2 or 3. It is loam.

The Bt horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is loam, silt loam, clay loam, or silty clay loam. The BC horizon has colors and textures similar to those of the Bt horizon.

Some pedons have a C horizon. This horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 3 to 5, and chroma of 3 to 6. It is fine sandy loam, sandy loam, loam, silt loam, clay loam, or silty clay loam.

Shelocta Series

The Shelocta series consists of deep and very deep, well drained soils on hills and mountains. Permeability is moderate. These soils formed in loamy colluvium or material weathered from sandstone and siltstone. Slopes range from 2 to 75 percent. Shelocta soils are fine-loamy, mixed, mesic Typic Hapludults.

Shelocta soils are associated on the landscape with Allegheny, Gilpin, Highsplint, Kimper, Cloverlick, Cutshin, and Sequoia soils. Cloverlick and Highsplint soils are loamy-skeletal. Cutshin soils have an umbric epipedon. Gilpin and Sequoia soils are moderately deep. Kimper soils have a dark surface layer and a cambic horizon. Allegheny soils are on stream terraces and contain waterworn pebbles.

Typical pedon of Shelocta gravelly loam, in an area of Shelocta-Highsplint complex, 35 to 75 percent slopes, very stony; on a south-facing, linear slope of 60 percent, at an elevation of 1,440 feet, in a forest of chestnut oak, white oak, and red maple; 3,300 feet northwest of the confluence of Oat Field Branch and Greasy Creek; about 1.2 miles west-southwest of Ingram, in Bell County; Kayjay quadrangle; Kentucky coordinates 2,566,050 feet east and 148,800 feet north:

Oi—2 inches to 0; partially decomposed leaves, roots, and twigs.

A—0 to 3 inches; dark brown (10YR 4/3) gravelly loam, pale brown (10YR 6/3) dry; moderate fine granular structure; friable; many very fine roots; about 15 percent rock fragments; very strongly acid; abrupt wavy boundary.

Bw—3 to 18 inches; yellowish brown (10YR 5/6) gravelly silt loam; moderate very fine subangular blocky structure; friable; common fine roots; about 15 percent rock fragments; very strongly acid; gradual wavy boundary.

2Bt1—18 to 31 inches; strong brown (7.5YR 5/6) loam; moderate fine subangular blocky structure; firm; few fine roots; common faint strong brown (7.5YR 5/6) clay films on faces of peds and few prominent red (2.5YR 4/6) clay films on the lower surfaces of peds or rock fragments; about 10 percent rock fragments; very strongly acid; gradual wavy boundary.

2Bt2—31 to 50 inches; strong brown (7.5YR 5/6) loam; weak medium subangular blocky structure; firm; few fine roots; common faint strong brown clay films on faces of peds and few prominent red (2.5YR 4/6) clay films on the lower surfaces of peds or rock fragments; about 10 percent rock fragments; very strongly acid; gradual wavy boundary.

2BC—50 to 60 inches; strong brown (7.5YR 5/6) channery loam; weak medium subangular blocky structure; firm; about 20 percent rock fragments; very strongly acid.

The thickness of the solum ranges from 40 to more than 60 inches. The depth to bedrock ranges form 48 to more than 60 inches. Rock fragments, mostly channers, make up 2 to 35 percent of the A horizon and 5 to 35 percent of the Bw, Bt, and BC horizons. Reaction is extremely acid to slightly acid in the A horizon and very strongly acid or strongly acid in the Bw and Bt horizons.

The A or Ap horizon has hue of 7.5YR, 10YR, or 2.5Y, generally has value of 4 or 5, and has chroma of 2 to 4. Some pedons have a thin A horizon with value of 3. The fine-earth fraction is silt loam or loam.

The Bw horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 or 5, and chroma of 4 to 6. The fine-earth fraction is silt loam or loam.

The Bt or 2Bt horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6, and chroma of 4 to 8. The fine-earth fraction is dominantly silt loam, silty clay loam, or loam. In some pedons, however, it is silty clay or clay in the part of the 2Bt horizon below a depth of 40 inches. The BC or 2BC horizon has colors and textures similar to those of the Bt or 2Bt horizon.

Some pedons have a C horizon. This horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is mottled in shades of brown, olive, or gray. The fine-earth fraction is silt loam, silty clay loam, loam, or clay loam.

Some pedons have a 2C horizon below a depth of 40 inches. The fine-earth fraction of this horizon is silty clay or clay. The content of rock fragments ranges from 15 to 70 percent. Reaction is very strongly acid or strongly acid.

Totz Series

The Totz series consists of shallow, somewhat excessively drained soils on mountains. Permeability is rapid. These soils formed in sandy residuum. Slopes range from 20 to 55 percent. Totz soils are mesic, coated Lithic Quartzipsamments.

Totz soils are associated on the landscape with Alticrest, Crossville, Helechawa, Jefferson, and Varilla soils. Alticrest and Crossville soils are moderately deep. Helechawa, Jefferson, and Varilla soils are deep or very deep.

Typical pedon of Totz fine sandy loam, in an area of Alticrest-Totz-Helechawa complex, rocky, 20 to 55 percent slopes; on a smooth, south-facing slope of 25 percent, at an elevation of 2,820 feet, in a forest of scarlet oak, chestnut oak, red maple, and pitch pine; 3,750 feet east-northeast of Jacks Gap and 30 feet south of the Little Shepherd Trail; about 1.6 miles east of Pine Mountain Settlement School, in Harlan County; Nolansburg quadrangle; Kentucky coordinates 2,758,800 feet east and 235,300 feet north:

Oi—1 inch to 0; leaves, roots, and twigs.

A—0 to 2 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak fine granular structure; very friable; many fine roots; about 5 percent gravel; very strongly acid; abrupt wavy boundary.

AB—2 to 7 inches; yellowish brown (10YR 5/4) fine sandy loam; weak fine granular structure; very friable; many fine roots; about 5 percent gravel; very strongly acid; clear smooth boundary.

Bw—7 to 13 inches; yellowish brown (10YR 5/6) loamy fine sand; weak very fine subangular blocky structure; very friable; common fine roots; about 5 percent gravel; very strongly acid; abrupt wavy boundary.

BC—13 to 18 inches; strong brown (7.5YR 5/6) loamy fine sand; weak medium subangular blocky structure; very friable; few fine roots; about 10 percent gravel; very strongly acid; abrupt wavy boundary.

R—18 inches; sandstone bedrock.

The thickness of the solum and the depth to bedrock range from 10 to 20 inches. The content of rock fragments, commonly gravel, is 0 to 35 percent throughout the profile. The soils generally are extremely acid to strongly acid throughout. In some pedons, however, the A horizon is medium acid or slightly acid.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 1 to 4. The AB horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. The fine-earth fraction is fine sandy loam, sandy loam, loamy fine sand, or loamy sand.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 8. The fine-earth fraction is loamy fine sand or loamy sand.

Some pedons have a C horizon. The BC and C horizons have colors and textures similar to those of the Bw horizon.

Varilla Series

The Varilla series consists of deep and very deep, somewhat excessively drained soils on mountains. Permeability is moderately rapid. These soils formed in stony, loamy colluvium or material weathered from sandstone and siltstone. Slopes range from 5 to 75 percent. Varilla soils are loamy-skeletal, siliceous, mesic Typic Dystrochrepts.

Varilla soils are associated on the landscape with Helechawa, Highsplint, Alticrest, Jefferson, and Totz soils. Alticrest soils are moderately deep. Helechawa soils are coarse-loamy. Highsplint soils have mixed mineralogy. Jefferson soils are fine-loamy. Totz soils are shallow.

Typical pedon of Varilla gravelly fine sandy loam, in an area of Helechawa-Varilla-Jefferson complex, very rocky, 35 to 75 percent slopes; on a southwest-facing, linear slope of 60 percent, at an elevation of 1,240 feet, in a forest of pitch pine, scarlet oak, and Virginia pine; 450 feet north of where Yellow Cliff Branch crosses United States Highway 119; about 0.9 mile west-northwest of Miracle, in Bell County; Balkan quadrangle; Kentucky coordinates 2,629,500 feet east and 164,300 feet north:

Oi—2 inches to 0; partially decomposed leaves, roots, and twigs.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) gravelly fine sandy loam; moderate very fine granular structure; very friable; many very fine roots; about 30 percent rock fragments; extremely acid; abrupt wavy boundary.

Bw1—3 to 10 inches; yellowish brown (10YR 5/4) gravelly fine sandy loam; weak fine subangular blocky structure; very friable; common medium roots; about 25 percent rock fragments; very strongly acid; clear wavy boundary.

Bw2—10 to 20 inches; yellowish brown (10YR 5/4) very cobbly fine sandy loam; weak medium subangular blocky structure; friable; common fine roots; about 40 percent rock fragments; extremely acid; clear wavy boundary.

Bw3—20 to 34 inches; yellowish brown (10YR 5/4) very cobbly fine sandy loam; weak medium subangular blocky structure; friable; few fine roots; about 50 percent rock fragments; extremely acid; gradual wavy boundary.

Bw4—34 to 45 inches; yellowish brown (10YR 5/4) extremely cobbly fine sandy loam; weak fine subangular blocky structure; friable; few fine roots; about 65 percent rock fragments; very strongly acid; gradual wavy boundary.

BC—45 to 64 inches; yellowish brown (10YR 5/6) extremely cobbly loamy sand; weak fine subangular blocky structure; very friable; common medium roots; few distinct strong brown (7.5YR 4/6) clay films on faces of peds; about 70 percent rock fragments; very strongly acid.

The thickness of the solum ranges from 40 to more than 60 inches. The depth to bedrock is 48 to more than 60 inches. Rock fragments, mostly cobbles and stones, make up 15 to 75 percent of the solum. Reaction commonly is extremely acid to strongly acid throughout the profile. In some pedons, however, the A horizon is medium acid or slightly acid.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 1 to 3. The fine-earth fraction is fine sandy loam or loam.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. The fine-earth fraction is sandy loam, loam, or fine sandy loam.

The BC horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 to 6. The fine-earth fraction is sand, fine sand, loamy sand, loamy fine sand, sandy loam, or fine sandy loam.

Some pedons have a C horizon. This horizon has colors and fine-earth textures similar to those of the Bw horizon. The content of rock fragments ranges from 35 to 90 percent.

Formation of the Soils

Soils are natural bodies on the Earth's surface that exhibit unique features and properties. Many properties can be measured in laboratories. Other properties, such as soil temperature, can only be measured or observed in the field. Soils form as certain horizons, or layers, develop in weathered parent material. Soil formation is determined by the interaction of topography, climate, and living organisms over a period of time. This section describes the processes of horizon differentiation, the factors of soil formation, and landforms and geologic relationships in the survey area.

Processes of Horizon Differentiation

Soil horizons form as parent material weathers. These horizons are layers distinguishable by such soil properties as color, structure, texture, and consistence. "Soil Taxonomy" identifies certain soil horizons or diagnostic features used in the classification system *(49)*. The major pedogenic processes and diagnostic features are described in this section.

Most soils have three major horizons, the A, B, and C horizons. The A horizon is the humus-rich, dark surface layer. If undisturbed, it has a loose granular structure. A surface layer that has been disturbed by plowing is termed the Ap horizon. The B horizon, or subsoil, underlies the A horizon. It is characterized by the maximum accumulation of dissolved or suspended material, such as iron and clay. It commonly is firmer than the overlying horizon and has blocky structure. Very young soils do not have a B horizon. Below the B horizon is the C horizon, which is little affected by the soil-forming processes but can be highly modified by weathering.

The size of particles in soils ranges from large rocks to very small clay minerals. Although some of the clay minerals formed through the weathering of larger particles, most of the differences among the soils in the survey area are the result of differences in the parent material. The smaller particles, especially the clay fraction, are subject to redistribution within the profile. As water moves downward through the soil, clay particles are removed from the A horizon and deposited as clay films in the subsoil. Although clay migration is

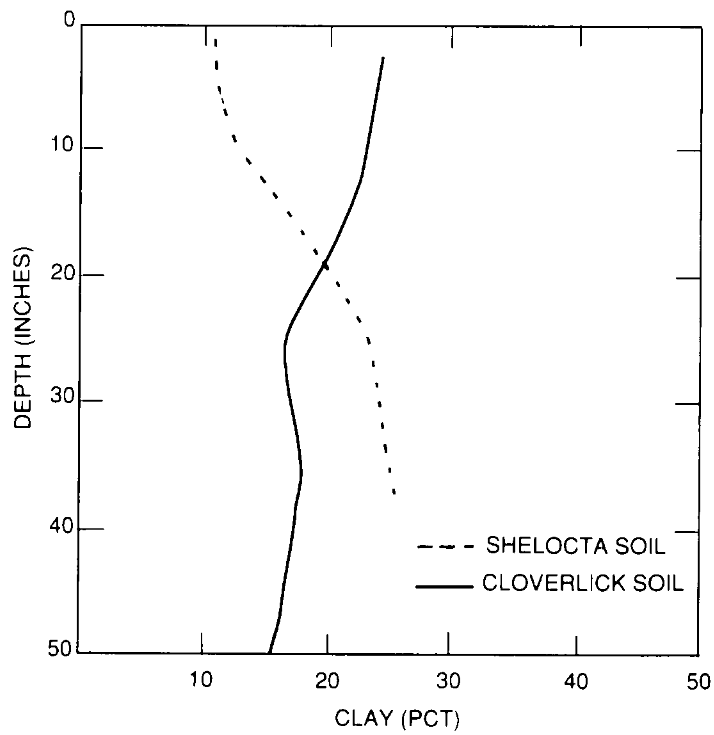

Figure 23.—Clay content as a function of depth in Cloverlick and Shelocta soils. Data from pedons described as typical of the series.

not the only cause of a high content of clay in the subsoil, it is presumed to be the dominant cause in the survey area. Most soils on the south- and west-facing slopes contain more clay in the subsoil than in the topsoil. These soils have clay films and are considered to have a weakly expressed argillic horizon. In contrast, soils that are on north- and east-facing slopes and have a moderately thick or thick, dark A horizon contain about the same amount of clay throughout the profile or have more clay in the A horizon than in the B horizon. An example of a soil with higher amounts of clay in the A horizon is shown in figure 23. Such soils have a well expressed cambic horizon.

The content of rock fragments commonly increases as depth increases. About half of the profiles on

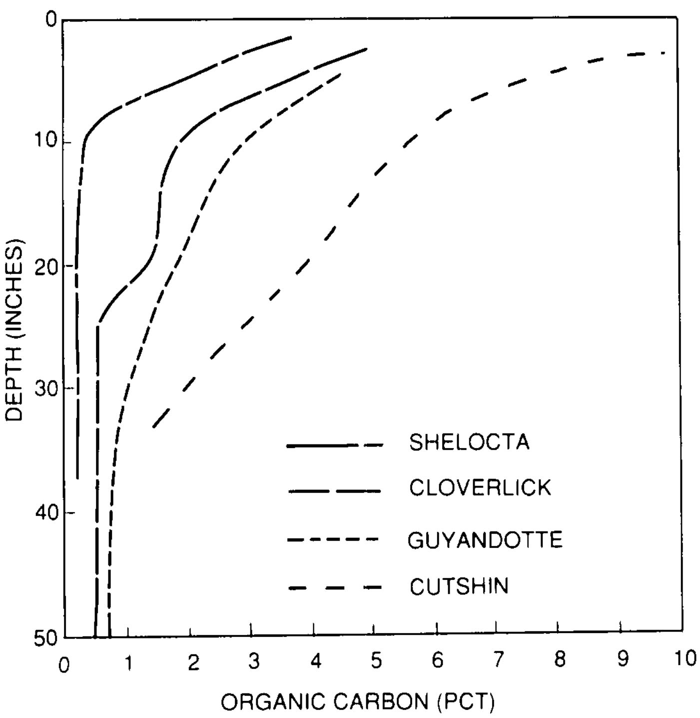

Figure 24.—Organic carbon as a function of depth in several soils. Data from pedons described as typical of the series, except for the Cutshin soil.

mountain slopes are characterized by a rather sharp increase in content of rock fragments at a depth of 20 to 40 inches.

Most soil horizons that have a high content of organic matter are dark. If the dark horizons are more than 10 inches thick, the soil commonly has a mollic epipedon or an umbric epipedon, depending on the content of bases. Sharondale soils have a mollic epipedon. Cutshin, Guyandotte, and Shelbiana soils have an umbric epipedon. Other soils have an ochric epipedon. An ochric epipedon is a surface layer that is not dark enough or not thick enough to be mollic or umbric. Commonly, it is only a few inches thick. A few of the soils in the survey area, such as Cloverlick and Kimper soils, have an uncommonly thick ochric epipedon.

In most soils the content of humus sharply decreases from the surface layer to the subsoil. The content of humus, or organic matter, commonly is estimated by multiplying the content of organic carbon by 1.7. The content of organic carbon in several soils is shown in figure 24. There may be a relationship between the zones where organic carbon accumulated and the quantity of tree roots *(28)*.

Soils that remain saturated for long periods generally are grayish and commonly are speckled with brownish mottles. Gleying is the process that yields the gray colors. It is caused by a combination of wetness and a low content of oxygen. The brownish mottles probably formed during occasional periods when the soil was dry. Bonnie soils have a light brownish gray, mottled subsoil as a result of gleying. These soils are saturated throughout the winter and spring and occasionally are dry during late summer.

Factors of Soil Formation

The characteristics of a soil are determined by parent material, topography, climate, living organisms, and time. All five factors are active in the formation of every soil, but the relative importance of each factor differs from soil to soil. When any of the five factors is varied to a significant extent, a different soil may form *(26)*. The interaction of the five factors of soil formation is more complex for some soils than for others. The five factors and how they interact are described in the following paragraphs.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It is a product of the weathering or decomposition of underlying bedrock or transported materials. Parent material influences the chemical, mineral, and textural composition of the soil. In the early stages of soil formation, a soil has properties similar to those of the parent material. As weathering takes place, these properties are modified and each soil develops its own characteristics. Shelocta and Helechawa soils illustrate how the mineral and textural composition is determined by the parent material. Shelocta soils formed partly in material weathered from mixed sandstone and siltstone containing small amounts of mica. Helechawa soils formed dominantly in material weathered from sandstone and siltstone containing only trace amounts of mica. Shelocta soils contain more mica and more clay than Helechawa soils. Shelocta soils have mixed mineralogy and are fine-loamy. Helechawa soils have siliceous mineralogy and are coarse-loamy.

The general types of parent material in the survey area are residual material that weathered in place from rocks similar to those of the underlying bedrock, colluvial material moved by gravity from ridges and the upper slopes and deposited on the lower slopes, alluvium deposited on flood plains by streams, and mine spoil and other material in highly disturbed areas.

Because of the dissected mountainous terrain, soils formed completely in residual material in only a few places in the uplands. The residual soils generally are on the crests of ridges and commonly are shallow or moderately deep. The shallow, sandy Totz soils are an example. They are underlain by fine grained sandstone. They have a low content of clay and a high content of sand because of the weathering of the underlying sandstone. In many places the boundary between the soil and the underlying bedrock is very diffuse and may extend over a depth of several feet.

Colluvial material is dominantly in the uplands. Most of the soils that formed in this material show some degree of mixing at least in the upper part. In the typical pedon of Shelocta soils, differences in texture and in the content of rock fragments indicate that the upper part of the profile formed in colluvial material and the lower part in mostly residual material. Cloverlick soils formed in deep or very deep colluvial material near the base of the mountains.

Numerous areas of stony, loamy colluvium or loamy colluvium are within the grooves on the mountainsides or occur as cone- or fan-shaped deposits at the mouth of the grooves. Some of these deposits develop slowly over a period of time by alluvial or colluvial processes. Other areas may result from debris avalanches *(78)*. Varilla soils in a large area on the divide between Clear Fork and Cubage Creek along the base of Cumberland Mountain in Bell County formed in stony, loamy colluvium.

Alluvial material deposited by the Cumberland River and by its smaller tributaries covers about 4 percent of the survey area. This material was sorted as it was deposited. Examples of this sorting are evident in areas of Craigsville, Pope, and Shelbiana soils. Craigsville soils are dominantly gravelly and are along the upper reaches of the streams, Pope soils are dominantly sandy loam and are along the middle reaches, and Shelbiana soils are dominantly loam or clay loam and are along the lower reaches and along the major streams.

Mine spoil and material in other highly disturbed areas occur throughout the survey area. In areas that are surface mined for coal, the overburden, or soil material and bedrock, is removed. The remaining spoil material is mainly broken and crushed bedrock. Other highly disturbed areas result from earth-moving activities associated with urban development and highway construction.

Topography

Topography pertains to the variations of the land surface. The survey area can be divided into areas of different landforms, which are described in the section "Landforms and Geologic Relationships."

Most soils in the uplands are deeper at or near the base of a slope because of the accumulation of colluvial material that has moved downhill from the upper slopes. Water also moves downslope laterally through the profile, carrying minerals in solution. These minerals include plant nutrients, which can be absorbed by the soil or roots. Thus, the soils on the lower slopes generally have a somewhat higher base saturation and a higher content of humus than the soils on the upper slopes. The additional moisture improves plant growth.

On mountainsides or irregular land surfaces, the type of soil and the vegetation are partly determined by aspect and slope. Orientation of the slope moderates or intensifies the effects of climate. Because of variations in the shading effects of the mountainous terrain, the amount of solar radiation that reaches the forest floor varies. On south- and west-facing slopes, the layer of leaf litter dries more quickly after a rain. On north- and east-facing slopes, snow and ice remain for longer periods. Because the soil is cooler and is moist for a longer period on north- and east-facing slopes, more humus accumulates in the upper part of the profile. As a result, some soils on northeast-facing slopes, such as Guyandotte soils, have an exceptionally thick, dark A horizon. The most common tree species on these soils are sugar maple, yellow buckeye, and basswood. In contrast, the soils on southwest-facing slopes commonly have an A horizon that is only a few inches thick and is paler in color. On these drier soils, the most common tree species are chestnut oak and black oak. Differences in the understory and the herbaceous layer on opposing slopes are significant *(9)*. These differences have been studied in more detail in Breathitt County, Kentucky, to the north of the survey area *(24)*.

Topography generally determines water movement and depth to the water table. On steep mountainsides water generally moves parallel to the surface because of increases in the degree of bulk density within the soil profile. The increased bulk density retards the downward movement of water by gravity. Water moves laterally down the mountain through a zone in the subsoil. In nearly level areas of Shelbiana soils, water moves vertically through the profile. In soils in slightly depressional areas, such as Bonnie soils, water moves very slowly. These soils remain saturated during most of the period when plants are dormant. In soils in seepy areas, such as Bonnie and Philo soils, water moves from the adjacent mountains across valley floors to stream channels. The excess water results in gleying or grayish mottles in the soils.

Climate

Climate affects the kind and number of plants and animals on and in the soils, the weathering of rocks and minerals, the susceptibility of the soils to erosion, and the rate of soil formation.

The climate of the survey area is temperate and

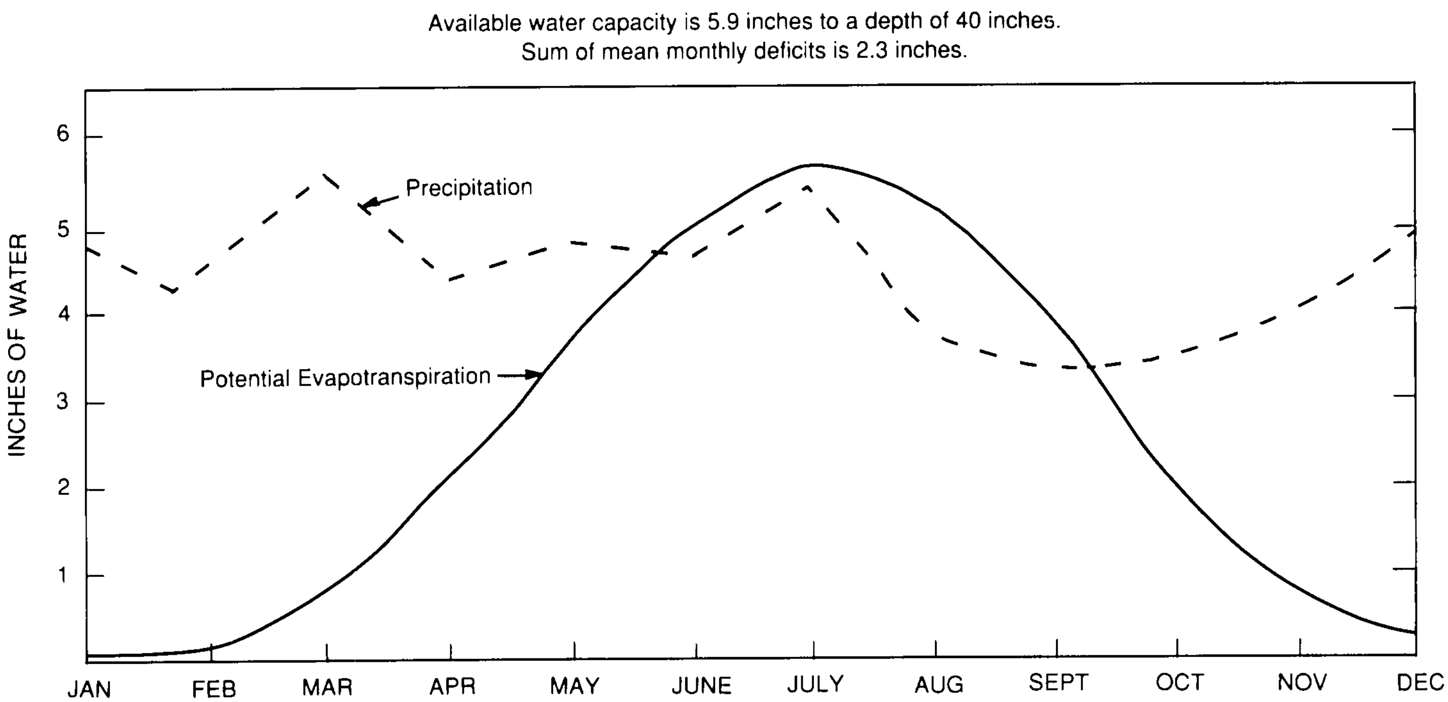

Figure 25.—Mean monthly water balance in an area of Shelocta soils at Middlesboro, Kentucky. Potential evapotranspiration calculated from climatic data recorded at Cumberland Gap National Historical Park, 1957-76.

humid. The average temperature is about 35 degrees F in winter and 73 degrees in summer. Periods of extremely low or high temperatures are short. Temperature varies from low to high elevations, especially in spring. Hardwoods reach full canopy about 4 weeks later at the higher elevations than at the lower elevations. The average annual soil temperature differs by about 3 degrees between the low and high elevations on Black Mountain. The average annual soil and air temperatures decrease about 1 degree per 550-foot increase in elevation.

The average annual precipitation is about 50 inches. The precipitation is fairly well distributed throughout the year. Under average conditions, the monthly precipitation exceeds or nearly equals the potential evapotranspiration in all months, except for August and September (fig. 25). On the average, tree growth is retarded for periods of a few days less than six times per growing season *(41)*.

This plentiful moisture supports a productive forest. As large amounts of organic material are returned to the soil, soils develop a moderate to high content of humus in the surface layer.

The abundance of moisture leaches many of the soluble bases from the soil. The result is soils that have a typically acid subsoil. Water also carries clay minerals from the surface layer into the subsoil, and most soils have a higher content of clay in the subsoil than in the surface layer. Leaching and clay translocation is most pronounced in soils that have a low content of humus, such as the Shelocta and Helechawa soils.

Living Organisms

Variations in forest composition are related to differences in topography, elevation, and soils. In the Dissected Cumberland Plateau and the Central Mountains, white oak and beech are on southern exposures, especially at the lower elevations *(23)*. On narrow crests and other dry sites, chestnut oak is abundant. Elsewhere, sugar maple, yellow poplar, buckeye, basswood, beech, and northern red oak are dominant. At elevations of more than about 2,000 feet, sugar maple is more abundant and beech and white oak are less abundant. At the highest elevations on Black Mountain, black cherry and yellow birch are dominant. Some areas on Pine and Cumberland Mountains have large amounts of pine, especially on shallow or droughty soils *(7, 8, 9)*. Pine is common on Alticrest and Totz soils. These soils have siliceous mineralogy and are very low in content of plant nutrients.

Trees and other plants in the forest community have significantly affected soil formation *(36)*. Mature trees require a large root system for support and a supply of water and nutrients. As the roots decay, soil material from the upper horizons fills the old root channels. The result is pockets of dark material in many forested soils, such as Kimper soils. The old root channels have more humus and are more porous than those in the surrounding soils. They are most prevalent in the upper part of the subsoil, generally within a depth of about 2 feet.

When trees are blown down during periods of high winds, a large amount of soil is unearthed with the roots. These tree-tip mounds are common in the survey area. They alter the topography on a small scale. Although only a small area is affected by one tree, over a period of many years the surface layer is mixed with the underlying subsoil. The cumulation of this mixing can greatly affect soil formation *(13)*.

Most of the organic matter from a forest community is deposited on the surface as leaf litter. The chemical differences in vegetation affect soil formation. As it decomposes, the litter from pine, rhododendron, and mountain laurel produces more organic acids than the litter from sugar maple and many other hardwoods. Soils that form under layers of acid-forming litter tend to be more highly leached than other soils and commonly have very low base saturation. The layer of leaf litter also helps to recycle nutrients, reduces the depth to which frost penetrates, helps to retain moisture, and reduces the hazard of erosion on steep slopes.

The forest community affects the thickness of humus-rich horizons. The kind and abundance of vegetation are significant. The overstory and understory and the herbaceous layer interact with other factors, such as climate, to produce organic matter. The presence of a thick, humus-rich A horizon is associated with a dense cover of abundant flora, especially in spring.

Fire affects the thickness of the humus-rich horizons. As the leaf litter burns, plant nutrients are released. The nutrients can be carried away by heavy rains following the fire. The hazard of erosion control is increased, and runoff can remove part of the surface soil. Leaf litter dries more rapidly on southern exposures than on northern exposures. As a result, fire destroys more of the litter on the drier slopes.

Many animals, such as earthworms, crawfish, centipedes, and moles, inhabit the soil. Earthworms digest organic matter and leave behind casts in their burrows. The amount of identifiable casts in the soil indicates the amount of mixing. In the umbric epipedon of Shelbiana soils, earthworm casts make up to 30 percent of the volume. Crawfish excavate large tunnels and bring soil to the surface. Bonnie soils commonly have many crawfish tunnels. Unless the water table is at the surface, the tunnels help to control runoff by allowing water to flow rapidly into the subsoil. Other animals that spend at least part of their life in the soil include many kinds of insects, mice, and groundhogs.

Humans have affected soil formation by clearing forests, draining wet areas, and plowing. From 1800 to about 1930, corn was grown on many of the mountain slopes *(27)*. Piles of stones and nearly pure stands of yellow poplar or pine are evidence of this earlier land use. In places human activities have so altered the soil that a different soil has formed. Disturbances result from coal-mining activities and the grading, shaping, and filling associated with road construction and urban development. Fairpoint and Bethesda soils formed in coal-mining spoil. Udorthents formed in urban areas where the surface has been disturbed.

Time

Time is needed for climate, living organisms, and topography to act upon the parent material and form a soil. Soil formation is evident even in mine spoils. Several changes are noticeable within a few years. A weak or moderate structure develops. Many rock fragments soften and are easily crushed. A thin A horizon forms. In Wise County, Virginia, mine spoils only 4 or 5 years old have an A horizon that is about 5 inches thick *(14)*. The age of Fairpoint and Bethesda soils ranges from less than 1 year to about 30 years. For most of the other soils in the survey area, estimates of the time of soil formation are not available. Archaeological investigations of the floodwall at Pineville have determined that the umbric epipedon in Shelbiana soils formed in deposits less than about 5,000 years old.

Landforms and Geologic Relationships

Landforms are the features that make up the land surface *(40)*. The survey area is divided into four different landforms: Pine and Cumberland Mountains, the dissected Cumberland Plateau, the Central Mountains, and the Middlesboro basin. These landforms are the product of differential erosion on the underlying bedrock. Figure 26 shows the relationships among the landforms, the underlying rock strata, and the general soil map units.

During the uplift of the Appalachian Mountains to the east, rock formations were deformed or displaced. A large block or plate of rock was pushed up and over the terrain to the west and formed the Pine Mountain overthrust plate. Pine Mountain is the leading edge of the thrust plate, and Cumberland Mountain is the trailing edge *(21)*.

Pine and Cumberland Mountains.—These monoclinal, linear mountains are on the upturned edges of the thrust plate. They are the dominant surface feature on

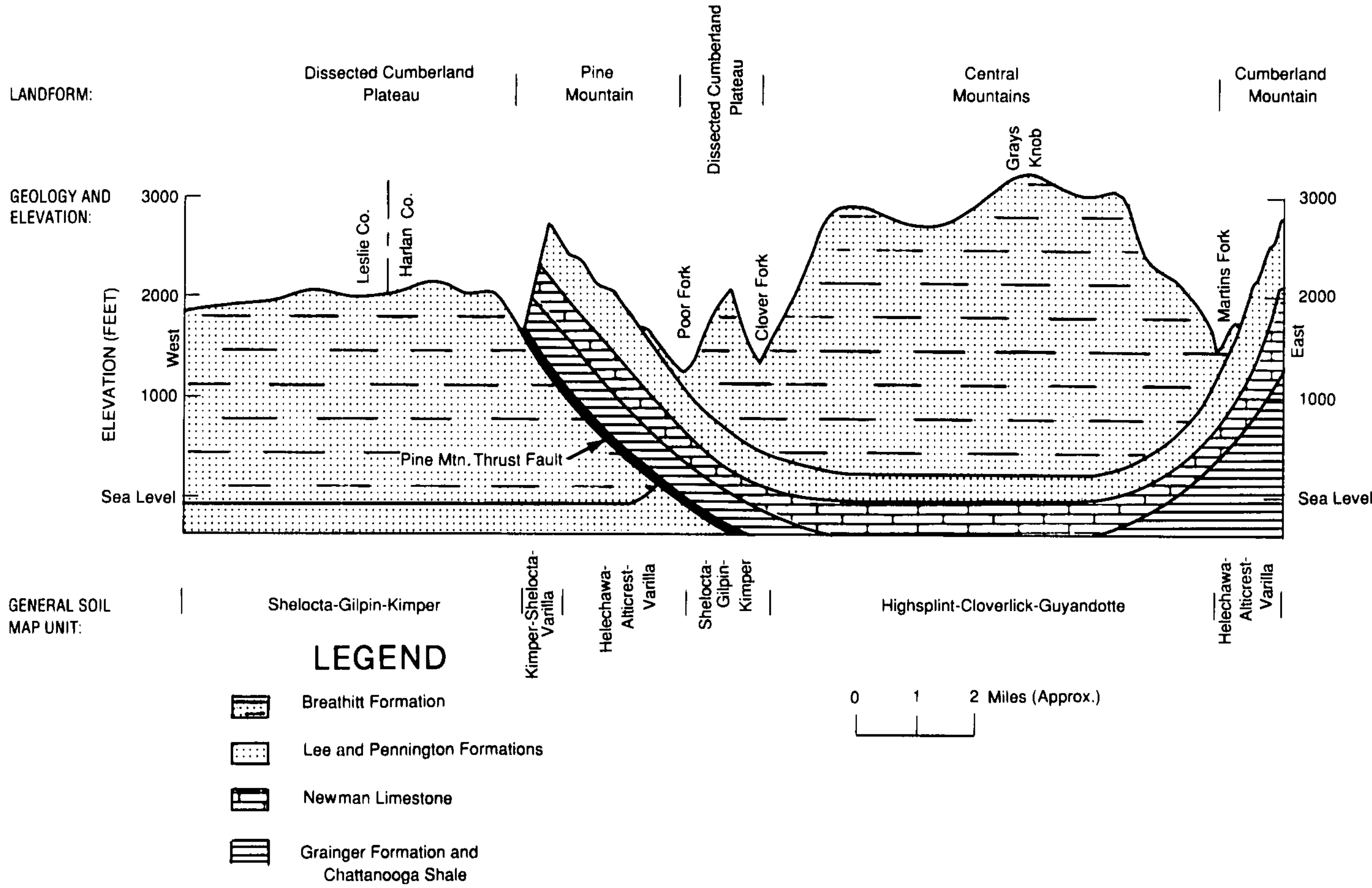

Figure 26.—An idealized cross-section of the survey area showing relationship among landforms, geology, and general soil map units.

satellite image maps of southeast Kentucky and the adjacent area *(76)*.

Pine Mountain lies in a northeast-southwest direction and extends about 120 miles. Cumberland Mountain, or Stone Mountain in Virginia, lies to the south of and is roughly parallel to Pine Mountain. The distance from crest to crest is about 10 to 13 miles.

The middle part of the north-facing slope, or scarp slope, of Pine Mountain has a narrow band of the Devonian and Mississippian Systems. These systems include Chattanooga Shale, the Grainger Formation (shale and siltstone), Newman Limestone, and the Pennington Formation (sandstone, shale, and limestone). The lower slopes, below the fault zone, commonly have strata of the Pennsylvanian System. The faulting is complex, and, in places, variations from the typical pattern occur. The southeast-facing slope of the mountain is the dip slope and is made up of strata of the Lower Pennsylvanian System. The strata dip at angles ranging from 15 to 70 degrees. Cliffs and hogbacks are common. The strata include the Pennington and Lee Formations and the lower part of the Breathitt Group. The Lee Formation is the most extensive. It is relatively coarse grained sandstone, commonly pebbly, and, in places, conglomeratic. The sandstone contains 90 to more than 99 percent quartz *(37)*. Intermingled with the Lee Formation are lesser amounts of the Breathitt Group. This group contains sandstone (subgraywacke), siltstone, shale, and some coal *(39)*. Coalbeds are thin and generally cannot be economically mined. Only two streams cross Pine Mountain—the Cumberland River at Pineville, Kentucky, and Clear Fork, in Tennessee.

Only the dip slope of Cumberland Mountain is within the survey area. The rock formations are the same as those on the dip slope of Pine Mountain. In most places, the rock strata dip more steeply than on Pine Mountain and cliffs and hogbacks are more common. On the crest of Brush Mountain, which lies adjacent to Cumberland Mountain behind the trailing edge of the thrust plate, the strata are nearly horizontal.

The elevations along the crest of Pine Mountain range from about 2,100 feet in the southwestern part of Bell County to about 2,800 feet in the northern part of Harlan County. At these elevations the relief is about 700 and 1,200 feet, respectively. Except for the Cumberland Gap, the elevations along the crest of Cumberland Mountain range from about 2,000 feet south of the gap to 3,515 feet near White Rocks and the Bell-Harlan County line. The relief on the Kentucky side of the mountain ranges from about 800 to 2,000 feet.

Dissected Cumberland Plateau.—This plateau consists of areas of similar elevation and relief that lie between Pine and Cumberland Mountains. It lies in an area north of Pine Mountain where the tops of the ridges are all about the same general elevation and make up the remnants of a former landform. The mountain crests generally are 1,600 to 2,500 feet in elevation and have a relief of 600 to 1,200 feet.

Underlying the plateau are nearly horizontal Pennsylvanian strata made up entirely of the Breathitt Formation, or the Breathitt Group. This formation is a sequence of sandstone (subgraywacke), siltstone, shale, coal, and underclay *(39)*. In contrast with the well sorted sandstone of the Lee Formation, the sandstone of the Breathitt Group is poorly sorted, generally is finer grained, and contains feldspar and conspicuous mica *(37)*. It contains a number of coalbeds that are mined by underground and surface methods. There are several large surface mines. The underground mines have drift entrances. Most of the coal has a heating value that averages about 13,000 to 15,000 Btu *(30)*.

Central Mountains.—These mountains are the massive, discontinuous ridges between Pine and Cumberland Mountains *(9)*. In this soil survey, the Central Mountains refer only to the larger relief mountains. These mountains, including Black, Little Black, and the higher parts of Log Mountains, are about 800 to 2,000 feet above the highest part of the dissected Cumberland Plateau. Like the Cumberland Plateau, they are underlain by nearly horizontal strata of the Breathitt Formation or Group. The rock strata are the same as those north of Pine Mountain, but the vertical intervals between certain strata can be more than one-third thicker *(38)*. The mountains contain a number of coalbeds, which are mined by underground and surface methods. The underground mines have drift entrances. Most of the surface mines are small and are mined by auger methods. A large surface mine is located at the headwaters of Little Clear Creek, in Bell County. Most of the coal has a heating value that averages about 13,000 to 15,000 Btu *(30)*.

Along the crests of the Central Mountains, elevations range from about 3,000 feet to 4,145 feet. The highest elevation is on Black Mountain. It is the highest point in Kentucky *(32)*. The relief of these mountains ranges from about 1,200 to 2,200 feet.

Middlesboro basin.—This basin lies within the mountains surrounding the city of Middlesboro. Within the low hills of the basin, the geologic formations are deformed and numerous small faults occur as concentric rings about the city *(9)*. One theory suggests that this site resulted from an ancient meteor impact *(17)*. The basin probably formed because the broken formations were less resistant to weathering and were reduced at a faster rate than the surrounding mountains. The formations underlying this area are part of the Breathitt Formation. The elevations of the basin are less than 1,600 feet, and the relief is about 80 to 240 feet.

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Glossary

Alluvial fan. A body of alluvium, with or without flow deposits, with a surface that forms a segment of a cone radiating downslope from the point where a stream emerges from a narrow valley onto a less sloping surface.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 40-inch profile or to a limiting layer is expressed as:

Very low	less than 2.4
Low	2.4 to 3.2
Moderate	3.2 to 5.2
High	more than 5.2

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cool slope. A land surface that is inclined toward the north and east (315 to 135 degrees on the compass).

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Debris. Any surficial accumulation of loose material detached from rock masses by chemical means, such as decay and disintegration. It remains in the place where it formed or is transported by water or ice and redeposited. It consists of rock fragments, finer grained earth material, or organic matter.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geological processes acting over long geological periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, such as fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay are in the soil. The soil is not a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Highwall. A vertical wall of overburden exposed during surface mining.

Hogback. A sharp-crested, symmetric ridge formed by highly tilted resistant rock layers produced by differential erosion of interlayered resistant and weak rocks.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Infiltration. The downward entry of water into the immediate surface of soil or other material. This contrasts with percolation, which is movement of water through soil layers or material.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments that are 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Natural levee. A long, broad, low ridge or embankment of sand and coarse silt that was built up by a stream onto a flood plain and along both sides of the channel. It occurs as wedge-shaped deposits of the coarsest textured suspended load material that slope gently away from the stream.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move through the profile. Permeability is measured as the number of inches per hour that water moves through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Piping (in tables). Subsurface tunnels or pipelike cavities are formed by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Reaction, soil. A measure of the acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered, mineral material that accumulated as consolidated rock disintegrated in place.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slippage (in tables). The soil mass is susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. The slope classes in this survey are:

Nearly level	0 to 2 percent
Gently sloping	2 to 6 percent
Sloping	6 to 12 percent
Moderately steep	12 to 20 percent
Steep	20 to 35 percent
Very steep	more than 35 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the Earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil depth. The distance from the top of the soil to the underlying bedrock. The distance, in inches, is expressed as:

Shallow	0 to 20
Moderately deep	20 to 40
Deep	40 to 60
Very deep	more than 60

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Spur. A secondary divide between minor drainage systems. It generally has an inverted V shape and is lower in elevation than associated ridges.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subgraywacke. Impure sandstone consisting of mixtures of sand, silt, and clay and containing less than 25 percent feldspar.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed on the contour or at a slight angle to the contour across sloping soils. The terrace intercepts surface runoff, so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). An otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Unstable fill (in tables). There is a risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Warm slope. A land surface that is inclined toward the south and west (135 to 315 degrees on the compass).

Water break (water bar). An obstruction usually constructed of dirt, rock, logs, or other material and installed at a 30-degree angle across the slope (usually on a road) to divert water. It should have a drop or grade of 6 inches to prevent water accumulation.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-87 at Baxter, Kentucky)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	43.3	22.2	32.8	68	-9	72	4.27	2.22	5.94	9	5.6
February----	47.9	24.6	36.3	72	-2	92	4.03	2.21	5.23	8	3.9
March-------	57.1	31.7	44.4	81	13	205	4.90	2.67	6.56	10	1.3
April-------	68.6	40.3	54.5	88	23	435	4.04	2.30	5.38	8	.7
May---------	77.0	50.1	63.6	90	31	732	4.46	2.53	6.03	9	.0
June--------	83.5	58.5	71.0	94	43	930	4.40	2.67	5.81	8	.0
July--------	86.5	63.0	74.8	95	50	1,079	4.89	2.79	6.46	9	.0
August------	85.6	62.2	73.9	94	50	1,051	4.08	2.15	5.54	8	.0
September---	80.1	55.6	67.9	93	39	837	3.24	1.47	4.58	6	.0
October-----	69.1	42.7	55.9	85	24	493	2.95	1.11	4.43	6	.0
November----	57.8	32.9	45.4	77	14	198	3.93	2.29	5.33	8	1.1
December----	47.3	25.8	36.6	71	2	93	4.17	2.17	5.61	8	1.9
Yearly:											
Average---	67.0	42.5	54.8	---	---	---	---	---	---	---	---
Extreme---	---	---	---	96	-9	---	---	---	---	---	---
Total-----	---	---	---	---	---	6,217	49.36	42.68	54.71	97	14.5

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-87 at Baxter, Kentucky)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 9	Apr. 23	May 11
2 years in 10 later than--	Apr. 3	Apr. 19	May 5
5 years in 10 later than--	Mar. 23	Apr. 10	Apr. 25
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 24	Oct. 19	Oct. 9
2 years in 10 earlier than--	Oct. 30	Oct. 24	Oct. 14
5 years in 10 earlier than--	Nov. 10	Nov. 2	Oct. 23

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-87 at Baxter, Kentucky)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	211	189	159
8 years in 10	218	194	166
5 years in 10	231	205	180
2 years in 10	244	216	193
1 year in 10	251	221	200

TABLE 4.--COMPOSITION AND STATISTICAL VARIABILITY OF SELECTED MAP UNITS

(SD means standard deviation; SE, standard error of the mean; CI, confidence interval; and P, level of probability. See text for calculation method used and examples of statements expressing map unit variability)

Map symbol, number of statistical samples (N) and total observations (TO), and soil name	Number of observations*	Mean	Statistical measures of variability-- SD	SE	CI P=0.80	CI P=0.90
		Pct	Pct	Pct	Pct	Pct
AtF:						
(N=7; TO=88)						
Alticrest and similar soils	33	37.5	10.3	3.9	32-43	30-45
Totz and similar soils	17	19.3	4.5	1.7	17-22	16-23
Helechawa and similar soils	18	20.5	12.0	4.5	14-27	12-29
Contrasting inclusions	20	22.7	8.6	3.2	18-27	16-29
Bo:						
(N=5; TO=34.3)						
Bonnie and similar soils	31	90.4	11.8	5.3	82-99	79-100
Contrasting inclusions	3.3	9.6	11.8	5.3	2-18	0-21
CgF:						
(N=5; TO=57)						
Cloverlick and similar soils	26	45.6	9.9	4.4	39-52	36-55
Guyandotte and similar soils	12	21.1	10.5	4.7	14-28	11-31
Highsplint and similar soils	13	22.8	8.9	4.0	17-29	14-31
Contrasting inclusions	6	10.5	7.8	3.5	5-16	3-18
Cr:						
(N=8; TO=58.4)						
Craigsville and similar soils	33	56.5	12.2	4.3	50-63	48-65
Philo and similar soils	17	29.1	9.5	3.3	24-34	23-35
Contrasting inclusions	8.4	14.4	8.8	3.1	10-19	9-20
GtF:						
(N=6; TO=74)						
Gilpin and similar soils	20	27.0	9.5	3.9	21-33	19-35
Shelocta and similar soils	17	23.0	8.7	3.6	18-28	16-30
Sequoia and similar soils	12	16.2	5.2	2.1	13-19	12-21
Contrasting inclusions	25	33.8	14.8	6.1	25-43	22-46
HeF:						
(N=5; TO=71)						
Helechawa and similar soils	17	23.9	8.2	3.7	18-30	16-32
Varilla and similar soils	22	31.0	14.3	6.4	21-41	17-45
Jefferson and similar soils	14	19.7	7.6	3.4	15-25	13-27
Contrasting inclusions	18	25.4	10.8	4.8	18-33	15-36
HsF:						
(N=5; TO=64)						
Highsplint and similar soils	34	53.1	13.0	5.8	44-62	41-66
Cloverlick and similar soils	12	18.8	12.5	5.6	10-27	7-31
Guyandotte and similar soils	6	9.4	8.8	3.9	3-15	1-18
Contrasting inclusions	12	18.8	7.0	3.1	14-24	12-26
Ph:						
(N=4; TO=32)						
Philo and similar soils	26	85.0	7.8	3.9	79-91	76-94
Contrasting inclusions	6	15.0	7.8	3.9	9-21	6-24

See footnote at end of table.

TABLE 4.--COMPOSITION AND STATISTICAL VARIABILITY OF SELECTED MAP UNITS--Continued

Map symbol, number of statistical samples (N) and total observations (TO), and soil name	Number of observations*	Mean	Statistical measures of variability-- SD	SE	CI P=0.80	CI P=0.90
		Pct	Pct	Pct	Pct	Pct
Po:						
(N=7; TO=51)						
Pope and similar soils	46	90.2	6.1	2.3	87-94	86-95
Contrasting inclusions	5	9.8	6.1	2.3	7-13	5-14
Sb:						
(N=6; TO=48.2)						
Shelbiana and similar soils	40	83.0	3.1	1.3	81-85	80-86
Contrasting inclusions	8.2	17.0	3.1	1.3	15-19	14-20
ShF:						
(N=6; TO=75)						
Shelocta and similar soils	46	61.3	9.4	3.8	56-67	54-69
Highsplint and similar soils	13	17.3	6.4	2.6	13-21	12-23
Contrasting inclusions	16	21.3	9.3	3.8	16-27	14-29
SkF:						
(N=5; TO=60)						
Shelocta and similar soils	18	30.0	12.6	5.7	21-39	18-42
Kimper and similar soils	17	28.3	4.6	2.0	25-31	24-33
Cloverlick and similar soils	12	20.0	9.5	4.2	14-27	11-29
Contrasting inclusions	13	21.7	7.5	3.3	17-27	15-29
SmF:						
(N=5; TO=70)						
Shelocta and similar soils	27	38.6	9.5	4.2	32-45	30-48
Kimper and similar soils	19	27.1	5.6	2.5	23-31	22-32
Cutshin and similar soils	7	10.0	7.7	3.4	5-15	3-17
Contrasting inclusions	17	24.3	10.1	4.5	17-31	15-34

* Fractional observations result from weighting the number of observations by the percentage of each stratum within a delineation. For example, 6 out of a total of 8 observations are made in a stratum. The stratum makes up 90 percent of the delineation. The number of observations for statistical analysis is equal to 90 percent of 8, or 7.2.

TABLE 5.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Bell County	Harlan County	Total-- Area	Total-- Extent
		Acres	Acres	Acres	Pct
AgB	Allegheny loam, 2 to 8 percent slopes	459	265	724	0.1
AtF	Alticrest-Totz-Helechawa complex, rocky, 20 to 55 percent slopes	14,497	21,898	36,395	6.9
Bo	Bonnie silt loam, occasionally flooded	826	67	893	0.1
CgF	Cloverlick-Guyandotte-Highsplint complex, 35 to 75 percent slopes, very stony	10,885	67,206	78,091	14.7
Cr	Craigsville-Philo complex, occasionally flooded	1,768	2,296	4,064	0.8
CsC	Crossville loam, 3 to 12 percent slopes	219	0	219	*
CsD	Crossville loam, 12 to 20 percent slopes	486	0	486	0.1
Du	Dumps, mine; tailings; and tipples	446	1,622	2,068	0.4
FbC	Fairpoint and Bethesda soils, 2 to 20 percent slopes	3,389	794	4,183	0.8
FbF	Fairpoint and Bethesda soils, 20 to 70 percent slopes	16,496	9,362	25,858	4.9
GsC	Gilpin-Shelocta silt loams, 3 to 12 percent slopes	387	73	460	0.1
GsD	Gilpin-Shelocta silt loams, 12 to 20 percent slopes	3,879	1,249	5,128	1.0
GtF	Gilpin-Shelocta-Sequoia complex, 25 to 55 percent slopes, very stony	29,075	20,750	49,825	9.4
HeF	Helechawa-Varilla-Jefferson complex, very rocky, 35 to 75 percent slopes	18,865	22,105	40,970	7.7
HgD	Highsplint very flaggy silt loam, 5 to 20 percent slopes, extremely bouldery	352	908	1,260	0.2
HsF	Highsplint-Cloverlick-Guyandotte complex, 35 to 75 percent slopes, very stony	9,743	46,588	56,331	10.6
JfD	Jefferson gravelly silt loam, 12 to 20 percent slopes	491	302	793	0.1
KmD	Kimper silt loam, 5 to 20 percent slopes, very stony	0	915	915	0.2
KrF	Kimper-Renox-Sharondale complex, very rocky, 35 to 75 percent slopes	2,474	2,251	4,725	0.9
Ph	Philo fine sandy loam, occasionally flooded	1,339	664	2,003	0.4
Po	Pope fine sandy loam, occasionally flooded	2,394	2,752	5,146	1.0
Sb	Shelbiana loam, occasionally flooded	1,960	656	2,616	0.5
SeB	Shelocta gravelly silt loam, 2 to 6 percent slopes	232	278	510	0.1
SeC	Shelocta gravelly silt loam, 6 to 12 percent slopes	194	233	427	0.1
SgE	Shelocta-Gilpin silt loams, 20 to 35 percent slopes	6,065	1,870	7,935	1.5
ShF	Shelocta-Highsplint complex, 35 to 75 percent slopes, very stony	43,799	29,862	73,661	13.9
SkF	Shelocta-Kimper-Cloverlick complex, 35 to 75 percent slopes, very stony	48,958	26,093	75,051	14.1
SmF	Shelocta-Kimper-Cutshin complex, 20 to 55 percent slopes, very stony	5,429	31,333	36,762	6.9
Ud	Udorthents-Urban land complex, occasionally flooded	2,009	3,465	5,474	1.0
UrC	Udorthents-Urban land complex, 3 to 15 percent slopes	945	1,053	1,998	0.4
UrE	Udorthents-Urban land complex, 15 to 35 percent slopes	743	1,330	2,073	0.4
VrD	Varilla very stony loam, 5 to 20 percent slopes, extremely bouldery	1,337	475	1,812	0.3
	Water areas less than 40 acres	826	85	911	0.2
	Water areas more than 40 acres	290	810	1,100	0.2
	Total	231,257	299,610	530,867	100.0

* Less than 0.1 percent.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Tobacco	Grass-legume hay	Pasture
		Bu	Lb	Ton	AUM*
AgB----------------------- Allegheny	IIe	115	3,000	4.0	8.0
AtF*---------------------- Alticrest-Totz-Helechawa	VIIe	---	---	---	---
Bo:					
Bonnie, undrained--------	Vw	---	---	---	6.0
Bonnie, drained----------	IIw	90	---	3.5	7.0
CgF*---------------------- Cloverlick-Guyandotte-Highsplint	VIIe	---	---	---	---
Cr*-----------------------		100	2,500	3.0	6.0
Craigsville--------------	IIIs				
Philo--------------------	IIw				
CsC----------------------- Crossville	IIIe	80	2,200	3.0	6.5
CsD----------------------- Crossville	IVe	65	---	2.5	5.5
Du**.					
Dumps, mine; tailings; and tipples-------------	VIIIs	---	---	---	---
FbC*---------------------- Fairpoint and Bethesda	VIs	---	---	---	2.5
FbF*---------------------- Fairpoint and Bethesda	VIIe	---	---	---	---
GsC*---------------------- Gilpin-Shelocta	IIIe	100	2,200	2.5	5.0
GsD*---------------------- Gilpin-Shelocta	IVe	90	2,000	2.5	5.0
GtF*---------------------- Gilpin-Shelocta-Sequoia	VIIe	---	---	---	---
HeF*---------------------- Helechawa-Varilla-Jefferson	VIIe	---	---	---	---
HgD----------------------- Highsplint	VIs	---	---	---	5.0
HsF*---------------------- Highsplint-Cloverlick-Guyandotte	VIIe	---	---	---	---

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Tobacco	Grass-legume hay	Pasture
		Bu	Lb	Ton	AUM*
JfD----------------------- Jefferson	IVe	100	2,000	3.0	6.0
KmD----------------------- Kimper	VIs	---	---	---	4.0
KrF*---------------------- Kimper-Renox-Sharondale	VIIe	---	---	---	---
Ph------------------------ Philo	IIw	115	2,800	3.5	7.0
Po------------------------ Pope	IIw	125	2,800	4.0	8.0
Sb------------------------ Shelbiana	IIw	140	3,200	4.0	8.0
SeB----------------------- Shelocta	IIe	110	2,500	4.0	8.0
SeC----------------------- Shelocta	IIIe	100	2,300	3.5	7.0
SgE*---------------------- Shelocta-Gilpin	VIe	---	---	---	5.0
ShF*---------------------- Shelocta-Highsplint	VIIe	---	---	---	---
SkF*---------------------- Shelocta-Kimper-Cloverlick	VIIe	---	---	---	---
SmF*---------------------- Shelocta-Kimper-Cutshin	VIIe	---	---	---	---
Ud**, UrC**, UrE**. Udorthents-Urban land					
VrD----------------------- Varilla	VIs	---	---	---	3.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

(Water areas are excluded. Dashes indicate no acreage)

Class	Total acreage	Major management concerns (subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I:				
Bell County	---	---	---	---
Harlan County	---	---	---	---
II:				
Bell County	7,003	691	6,312	---
Harlan County	5,419	543	4,876	---
III:				
Bell County	1,949	800	---	1,149
Harlan County	1,798	306	---	1,492
IV:				
Bell County	4,856	4,856	---	---
Harlan County	1,551	1,551	---	---
V:				
Bell County	826	---	826	---
Harlan County	67	---	67	---
VI:				
Bell County	11,143	6,065	---	5,078
Harlan County	4,962	1,870	---	3,092
VII:				
Bell County	200,221	200,221	---	---
Harlan County	277,448	277,448	---	---
VIII:				
Bell County	446	---	---	446
Harlan County	1,622	---	---	1,622

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Potential productivity: Common trees	Site index	Volume*	Trees to plant
AgB--- Allegheny	Slight	Moderate	Slight	Severe	Yellow poplar	93	95	Eastern white pine, yellow poplar, black walnut, shortleaf pine, white oak, white ash, northern red oak.
					Virginia pine	72	112	
					Sugar maple	---	---	
					Northern red oak	---	---	
					Red maple	---	---	
					Black oak	78	60	
					White oak	70	52	
AtF**:								
Alticrest---	Moderate	Moderate	Moderate	Moderate	Scarlet oak	60	43	Shortleaf pine, Virginia pine, loblolly pine, eastern white pine.
					Virginia pine	60	91	
					Shortleaf pine	60	88	
					Chestnut oak	---	---	
Totz---	Severe	Severe	Moderate	Slight	Scarlet oak	60	43	Shortleaf pine, Virginia pine.
					Black oak	52	36	
					Shortleaf pine	52	72	
					Virginia pine	52	73	
					Chestnut oak	54	38	
					White oak	54	38	
Helechawa---	Severe	Severe	Moderate	Moderate	Scarlet oak	70	52	White oak, shortleaf pine.
					Chestnut oak	65	47	
					White oak	65	47	
					Virginia pine	65	100	
Bo--- Bonnie	Slight	Severe	Severe	Severe	Pin oak	96	93	American sycamore, sweetgum, pin oak.
					Sweetgum	101	142	
					American sycamore	---	---	
					Red maple	---	---	
CgF**:								
Cloverlick---	Severe	Severe	Slight	Severe	Northern red oak	85	67	Yellow poplar, white ash, northern red oak, shortleaf pine, eastern white pine.
					Sugar maple	---	---	
					Yellow poplar	110	124	
					American basswood	---	---	
					Black locust	---	---	
					Yellow buckeye	---	---	
Guyandotte---	Severe	Severe	Moderate	Severe	Northern red oak	85	67	Black walnut, eastern white pine, northern red oak.
					American basswood	---	---	
					Yellow poplar	104	114	
					Black cherry	---	---	
					Black locust	---	---	
Highsplint---	Moderate	Severe	Moderate	Moderate	Yellow poplar	100	107	Northern red oak, eastern white pine, yellow poplar.
					Sugar maple	---	---	
					Chestnut oak	---	---	
Cr**:								
Craigsville---	Slight	Slight	Moderate	Moderate	Northern red oak	80	62	Eastern white pine, yellow poplar.
					Yellow poplar	95	98	
					Eastern white pine	90	166	
					American sycamore	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns				Potential productivity			Trees to plant
	Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	Volume*	
Cr**:								
Philo	Slight	Slight	Slight	Severe	Northern red oak	86	68	Eastern white pine, yellow poplar, white ash, shortleaf pine, black walnut.
					Yellow poplar	102	110	
					Virginia pine	74	114	
					Black oak	85	67	
					White oak	74	56	
CsC: Crossville	Slight	Slight	Slight	Moderate	Shortleaf pine	60	88	Shortleaf pine, loblolly pine, eastern white pine, northern red oak.
					Virginia pine	60	91	
					Northern red oak	60	43	
					Hickory	---	---	
					Chestnut oak	---	---	
CsD: Crossville	Moderate	Moderate	Slight	Moderate	Shortleaf pine	60	88	Shortleaf pine, loblolly pine, eastern white pine, northern red oak.
					Virginia pine	60	91	
					Northern red oak	60	43	
					Hickory	---	---	
					Chestnut oak	---	---	
FbC**:								
Fairpoint	Slight	Slight	Moderate	Moderate	Loblolly pine	74	100	Eastern white pine, black locust, loblolly pine, shortleaf pine, white ash.
					Yellow poplar	85	81	
					Eastern white pine	85	155	
					Black locust	---	---	
					Sweetgum	88	101	
Bethesda	Slight	Slight	Moderate	Moderate	Loblolly pine	69	101	Eastern white pine, shortleaf pine, black locust, loblolly pine.
					Shortleaf pine	63	95	
					Chestnut oak	73	55	
					Black locust	---	---	
FbF**:								
Fairpoint (warm aspect)	Severe	Severe	Moderate	Moderate	Loblolly pine	74	100	Eastern white pine, black locust, loblolly pine, shortleaf pine, white oak.
					White pine	85	155	
					Yellow poplar	85	81	
					Scarlet oak	72	54	
					Black locust	---	---	
Bethesda (warm aspect)	Severe	Severe	Moderate	Moderate	Loblolly pine	69	91	Eastern white pine, black locust, loblolly pine, shortleaf pine, white oak.
					Shortleaf pine	63	95	
					Black oak	73	55	
					Black locust	---	---	
FbF**:								
Fairpoint (cool aspect)	Severe	Severe	Moderate	Moderate	Loblolly pine	82	114	Eastern white pine, loblolly pine, shortleaf pine, yellow poplar, black locust, white oak.
					White pine	95	176	
					Northern red oak	75	57	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Potential productivity: Common trees	Site index	Volume*	Trees to plant
FbF**:								
Bethesda (cool aspect)	Severe	Severe	Moderate	Moderate	Loblolly pine	80	110	Eastern white pine, black locust, loblolly pine, shortleaf pine, yellow poplar, white oak.
					Yellow poplar	95	98	
					American sycamore	77	73	
					Red maple	---	---	
					Black locust	---	---	
					Chestnut oak	---	---	
GsC**:								
Gilpin	Slight	Slight	Slight	Moderate	White oak	75	57	Shortleaf pine, eastern white pine, northern red oak, yellow poplar, white oak.
					Yellow poplar	90	90	
					Chestnut oak	80	62	
					Virginia pine	71	110	
					Scarlet oak	76	58	
					Black oak	80	62	
Shelocta	Slight	Slight	Slight	Severe	White oak	79	61	Yellow poplar, black walnut, eastern white pine, shortleaf pine, white ash, white oak, northern red oak.
					Shortleaf pine	77	124	
					Yellow poplar	107	110	
					Cucumbertree	---	---	
					American beech	---	---	
					Black oak	79	61	
					Red maple	---	---	
GsD**:								
Gilpin (warm aspect)	Moderate	Moderate	Moderate	Moderate	White oak	61	44	Shortleaf pine, white oak, loblolly pine.
					Black oak	74	56	
					Scarlet oak	72	54	
					Chestnut oak	68	50	
					Shortleaf pine	60	88	
Shelocta (warm aspect)	Moderate	Moderate	Moderate	Moderate	Black oak	70	52	Shortleaf pine, white oak, eastern white pine.
					White oak	65	47	
					Scarlet oak	68	50	
					Yellow poplar	92	93	
					American beech	---	---	
					Red maple	---	---	
					Chestnut oak	68	50	
GsD**:								
Gilpin (cool aspect)	Moderate	Moderate	Slight	Moderate	White oak	75	57	Northern red oak, eastern white pine, yellow poplar, white oak.
					Yellow poplar	90	90	
					Chestnut oak	80	62	
					Scarlet oak	76	58	
					Black oak	80	62	
Shelocta (cool aspect)	Moderate	Moderate	Slight	Severe	White oak	79	61	Yellow poplar, black walnut, eastern white pine, white oak, northern red oak.
					Yellow poplar	102	110	
					Cucumbertree	---	---	
					American beech	---	---	
					Black oak	79	61	
					Red maple	---	---	
GtF**:								
Gilpin (warm aspect)	Severe	Severe	Moderate	Moderate	White oak	61	44	Shortleaf pine, white oak, loblolly pine.
					Black oak	74	56	
					Scarlet oak	72	54	
					Chestnut oak	68	50	
					Shortleaf pine	60	80	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns				Potential productivity			Trees to plant
	Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	Volume*	
GtF**:								
Shelocta (warm aspect)	Severe	Severe	Moderate	Moderate	Black oak	70	52	Shortleaf pine, white oak, eastern white pine.
					White oak	65	47	
					Scarlet oak	68	50	
					Yellow poplar	92	93	
					Blackgum	---	---	
					Red maple	---	---	
					Chestnut oak	68	50	
Sequoia (warm aspect)	Severe	Severe	Severe	Moderate	Northern red oak	70	52	Loblolly pine, shortleaf pine, eastern white pine, white oak.
					Shortleaf pine	68	95	
					Virginia pine	71	110	
GtF**:								
Gilpin (cool aspect)	Severe	Severe	Slight	Moderate	White oak	75	57	Shortleaf pine, eastern white pine, northern red oak, yellow poplar, white oak.
					Yellow poplar	90	90	
					Chestnut oak	80	62	
					Scarlet oak	76	58	
					Black oak	80	62	
Shelocta (cool aspect)	Severe	Severe	Slight	Severe	White oak	79	61	Yellow poplar, black walnut, eastern white pine, shortleaf pine, white ash, white oak, northern red oak.
					Yellow poplar	102	110	
					American beech	---	---	
					Northern red oak	79	61	
					Sugar maple	---	---	
Sequoia (cool aspect)	Severe	Severe	Slight	Moderate	Northern red oak	70	52	Loblolly pine, white oak, shortleaf pine, eastern white pine.
					White oak	63	45	
					Chestnut oak	---	---	
					Sugar maple	---	---	
HeF**:								
Helechawa (warm aspect)	Moderate	Severe	Moderate	Moderate	Scarlet oak	70	52	White oak, shortleaf pine.
					Chestnut oak	65	47	
					White oak	65	47	
					Virginia pine	65	100	
Varilla (warm aspect)	Moderate	Severe	Severe	Moderate	White oak	65	47	White oak, shortleaf pine.
					Scarlet oak	70	52	
					Virginia pine	---	---	
					Red maple	---	---	
Jefferson (warm aspect)	Severe	Severe	Moderate	Moderate	White oak	70	52	Shortleaf pine, white oak.
					Shortleaf pine	65	99	
					Virginia pine	70	100	
					Chestnut oak	63	46	
					Black oak	---	---	
					Pitch pine	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns				Potential productivity			Trees to plant
	Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	Volume*	
HeF**:								
Helechawa (cool aspect)	Moderate	Severe	Moderate	Moderate	White oak	75	57	Yellow poplar, white oak, eastern white pine, shortleaf pine.
					Chestnut oak	---	---	
					Yellow poplar	85	81	
					Virginia pine	75	115	
					Cucumbertree	---	---	
Varilla (cool aspect)	Moderate	Severe	Moderate	Moderate	White oak	75	57	Yellow poplar, white oak, shortleaf pine, eastern white pine.
					Yellow poplar	95	98	
					Eastern hemlock	---	---	
					American beech	---	---	
Jefferson (cool aspect)	Severe	Severe	Slight	Moderate	White oak	84	66	Yellow poplar, eastern white pine, shortleaf pine, eastern white pine.
					Yellow poplar	102	110	
					Chestnut oak	82	64	
					Red maple	---	---	
HgD Highsplint	Slight	Moderate	Moderate	Moderate	Yellow poplar	95	98	Yellow poplar, eastern white pine, shortleaf pine, yellow poplar.
					White oak	---	---	
					Sugar maple	---	---	
					Scarlet oak	---	---	
HsF**:								
Highsplint	Moderate	Severe	Moderate	Moderate	Yellow poplar	100	107	Northern red oak, eastern white pine, yellow poplar.
					Northern red oak	---	---	
					Sugar maple	---	---	
					Chestnut oak	---	---	
Cloverlick	Moderate	Severe	Moderate	Severe	Northern red oak	85	67	Yellow poplar, white ash, northern red oak, shortleaf pine, eastern white pine.
					Sugar maple	---	---	
					Chestnut oak	---	---	
					Red maple	---	---	
Guyandotte	Severe	Severe	Moderate	Severe	Northern red oak	85	67	Black walnut, white ash, eastern white pine, northern red oak.
					American basswood	---	---	
					Yellow poplar	104	114	
					Black cherry	---	---	
					Black locust	---	---	
					Sugar maple	---	---	
JfD Jefferson	Moderate	Moderate	Slight	Severe	White oak	84	66	Yellow poplar, eastern white pine, shortleaf pine.
					Yellow poplar	102	110	
					Shortleaf pine	80	130	
					Chestnut oak	82	64	
					Red maple	---	---	
KmD Kimper	Slight	Slight	Slight	Severe	Sugar maple	---	---	Yellow poplar, white ash, northern red oak, white oak, eastern black walnut.
					Sweet birch	---	---	
					Chestnut oak	70	57	
					Black cherry	---	---	
					Red maple	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns				Potential productivity			Trees to plant
	Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	Volume*	
KrF**:								
Kimper	Severe	Severe	Slight	Severe	Yellow poplar	107	119	Yellow poplar, white ash, northern red oak, white oak, eastern white pine, black walnut.
					Sugar maple	---	---	
					American basswood	---	---	
					American beech	---	---	
					Sweet birch	---	---	
					Northern red oak	75	57	
Renox	Severe	Severe	Slight	Severe	Yellow poplar	94	97	White oak, white ash, northern red oak, eastern white pine, yellow poplar, black walnut.
					Black walnut	---	---	
					American beech	---	---	
					Sweet birch	---	---	
					Sugar maple	---	---	
					Hickory	---	---	
					Red maple	---	---	
Sharondale	Severe	Severe	Slight	Severe	Yellow poplar	107	119	Yellow poplar, black walnut, northern red oak, white oak, eastern white pine.
					Black locust	---	---	
					American basswood	---	---	
					Northern red oak	---	---	
					Cucumbertree	---	---	
					Black watnut	---	---	
					Sugar maple	---	---	
Ph Philo	Slight	Slight	Slight	Severe	Northern red oak	86	68	Eastern white pine, yellow poplar, white ash, shortleaf pine, black walnut.
					Yellow poplar	102	110	
					Virginia pine	74	114	
					Black oak	85	67	
					White oak	74	56	
Po Pope	Slight	Slight	Slight	Severe	Yellow poplar	96	100	Eastern white pine, yellow poplar, black walnut, white oak, northern red oak, white ash, shortleaf pine.
					American beech	---	---	
					White oak	80	62	
					Blackgum	---	---	
					American sycamore	---	---	
					Northern red oak	---	---	
					Eastern hemlock	---	---	
Sb Shelbiana	Slight	Slight	Slight	Severe	Yellow poplar	110	124	Yellow poplar, black walnut, eastern white pine, northern red oak, white oak, sweetgum, white ash.
					Sweetgum	---	---	
					Black walnut	---	---	
					Green ash	---	---	
					American sycamore	---	---	
					Black cherry	---	---	
					Boxelder	---	---	
SeB, SeC Shelocta	Slight	Slight	Slight	Severe	White oak	78	61	Yellow poplar, black walnut, eastern white pine, shortleaf pine, white ash, white oak, northern red oak.
					Yellow poplar	102	110	
					American beech	---	---	
					Red maple	---	---	
					Black oak	79	61	
					Shortleaf pine	77	124	
					Sugar maple	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns				Potential productivity			Trees to plant
	Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	Volume*	
SgE**:								
Shelocta (warm aspect)	Moderate	Moderate	Moderate	Severe	Black oak	70	52	Shortleaf pine, white oak, eastern white pine.
					White oak	65	47	
					Scarlet oak	68	50	
					Yellow poplar	92	93	
					American beech	---	---	
					Red maple	---	---	
					Chestnut oak	---	---	
Gilpin (warm aspect)	Moderate	Moderate	Moderate	Moderate	Black oak	74	56	Shortleaf pine, white oak.
					White oak	61	44	
					Scarlet oak	72	54	
					Chestnut oak	68	50	
					Shortleaf pine	60	88	
SgE**:								
Shelocta (cool aspect)	Moderate	Moderate	Slight	Severe	White oak	79	61	Yellow poplar, black walnut, eastern white pine, shortleaf pine, white ash, white oak, northern red oak.
					Yellow poplar	102	110	
					American beech	---	---	
					Northern red oak	---	---	
					Red maple	---	---	
					Black oak	79	61	
					Sugar maple	---	---	
Gilpin (cool aspect)	Moderate	Moderate	Slight	Moderate	Black oak	80	62	Shortleaf pine, eastern white pine, yellow poplar, white oak.
					Yellow poplar	90	90	
					White oak	75	57	
					Scarlet oak	76	58	
					Chestnut oak	80	62	
					Sugar maple	---	---	
ShF**:								
Shelocta	Severe	Severe	Moderate	Severe	Black oak	70	52	Shortleaf pine, white oak, eastern white pine.
					White oak	65	47	
					Scarlet oak	68	50	
					Yellow poplar	92	93	
					American beech	---	---	
					Red maple	---	---	
					Chestnut oak	---	---	
Highsplint	Moderate	Severe	Severe	Moderate	Yellow poplar	90	90	White oak, shortleaf pine, eastern white pine.
					White oak	---	---	
					American beech	---	---	
					Chestnut oak	---	---	
					Red maple	---	---	
SkF**:								
Shelocta	Severe	Severe	Slight	Severe	White oak	79	61	Yellow poplar, black walnut, eastern white pine, shortleaf pine, white ash, white oak, northern red oak.
					Yellow poplar	102	110	
					Cucumbertree	---	---	
					American beech	---	---	
					Northern red oak	---	---	
					Red maple	---	---	
					Chestnut oak	79	61	
					Eastern hemlock	---	---	
					Sugar maple	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
SkF**:								
Kimper	Severe	Severe	Slight	Severe	Yellow poplar	107	119	Yellow poplar, white ash, northern red oak, white oak, eastern white pine, black walnut.
					Sugar maple	---	---	
					American basswood	---	---	
					American beech	---	---	
					Sweet birch	---	---	
					Northern red oak	75	57	
					White oak	72	54	
Cloverlick	Severe	Severe	Slight	Severe	Northern red oak	85	67	Yellow poplar, white ash, northern red oak, shortleaf pine, eastern white pine.
					Sugar maple	---	---	
					Yellow poplar	---	---	
					American beech	---	---	
SmF**:								
Shelocta	Severe	Severe	Slight	Severe	Northern red oak	65	50	Northern red oak, black cherry.
					Yellow poplar	99	105	
					Cucumbertree	---	---	
					Red maple	---	---	
					Chestnut oak	---	---	
					Sugar maple	---	---	
Kimper	Severe	Severe	Slight	Severe	Yellow poplar	107	119	Northern red oak, black cherry.
					Sugar maple	---	---	
					Sweet birch	---	---	
					Northern red oak	70	52	
Cutshin	Severe	Severe	Slight	Severe	Yellow poplar	106	114	Eastern white pine, northern red oak, black cherry.
					Northern red oak	75	57	
					Cucumbertree	---	---	
					Sweet birch	---	---	
					Sugar maple	---	---	
					Red maple	---	---	
					Black cherry	---	---	
VrD Varilla	Slight	Severe	Moderate	Moderate	White oak	65	47	White oak, yellow poplar, eastern white pine, shortleaf pine.
					Scarlet oak	70	52	
					Yellow poplar	85	81	
					Red maple	---	---	

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
AgB: Allegheny	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
AtF*:					
Alticrest	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Totz	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.	Severe: slope, depth to rock.
Helechawa	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Bo: Bonnie	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
CgF*:					
Cloverlick	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope.	Severe: small stones, slope.
Guyandotte	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope.	Severe: slope, small stones.
Highsplint	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones, slope.
Cr*:					
Craigsville	Severe: flooding.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones, large stones, flooding.
Philo	Severe: flooding.	Moderate: wetness.	Moderate: flooding, wetness.	Slight	Moderate: flooding.
CsC: Crossville	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: depth to rock, slope.
CsD: Crossville	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Du*. Dumps, mine; tailings; and tipples					

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
FbC*:					
Fairpoint	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Slight	Severe: small stones, droughty.
Bethesda	Moderate: slope, small stones, percs slowly.	Moderate: small stones, slope, percs slowly.	Severe: slope, small stones.	Slight	Severe: small stones, droughty.
FbF*:					
Fairpoint	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope.	Severe: small stones, droughty, slope.
Bethesda	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: small stones, droughty, slope.
GsC*:					
Gilpin	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope, depth to rock.
Shelocta	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
GsD*:					
Gilpin	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Shelocta	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
GtF*:					
Gilpin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Shelocta	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sequoia	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
HeF*:					
Helechawa	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Varilla	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
Jefferson	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
HgD Highsplint	Severe: large stones.	Severe: large stones.	Severe: slope, large stones.	Severe: large stones.	Severe: large stones.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
HsF*:					
Highsplint	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones, slope.
Cloverlick	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.
Guyandotte	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.
JfD: Jefferson	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.
KmD: Kimper	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
KrF*:					
Kimper	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
Renox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sharondale	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
Ph: Philo	Severe: flooding.	Moderate: wetness.	Moderate: flooding, wetness.	Slight	Moderate: flooding.
Po: Pope	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
Sb: Shelbiana	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
SeB: Shelocta	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
SeC: Shelocta	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Moderate: small stones, slope.
SgE*:					
Shelocta	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Gilpin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
ShF*:					
Shelocta	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
Highsplint	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones, slope.
SkF*:					
Shelocta	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
Kimper	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Cloverlick	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope.	Severe: slope, small stones.
SmF*:					
Shelocta	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Kimper	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
Cutshin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ud*, UrC*, UrE*. Udorthents-Urban land					
VrD Varilla	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: large stones, slope.	Moderate: large stones.	Severe: large stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
AgB----------------- Allegheny	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
AtF*:										
Alticrest---------	Very poor.	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Totz--------------	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.
Helechawa---------	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Bo----------------- Bonnie	Very poor.	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
CgF*:										
Cloverlick--------	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Guyandotte--------	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Highsplint--------	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Cr*:										
Craigsville-------	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
Philo-------------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
CsC---------------- Crossville	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
CsD---------------- Crossville	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Du*. Dumps, mine; tailings; and tipples										
FbC*, FbF*:										
Fairpoint---------	Very poor.	Very poor.	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.
Bethesda----------	Very poor.	Very poor.	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.
GsC*:										
Gilpin------------	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
Shelocta----------	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
GsD*:										
Gilpin	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Shelocta	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
GtF*:										
Gilpin	Very poor.	Poor	Good	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Shelocta	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Sequoia	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
HeF*:										
Helechawa	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Varilla	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Jefferson	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
HgD Highsplint	Poor	Poor	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
HsF*:										
Highsplint	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Cloverlick	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Guyandotte	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
JfD Jefferson	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
KmD Kimper	Poor	Poor	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
KrF*:										
Kimper	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Renox	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Sharondale	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Ph Philo	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
Po: Pope	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Sb: Shelbiana	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
SeB: Shelocta	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
SeC: Shelocta	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
SgE*:										
Shelocta	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Gilpin	Very poor.	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
ShF*:										
Shelocta	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Highsplint	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
SkF*:										
Shelocta	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Kimper	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Cloverlick	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
SmF*:										
Shelocta	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Kimper	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Cutshin	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Ud*, UrC*, UrE*. Udorthents-Urban land										
VrD: Varilla	Very poor.	Very poor.	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AgB: Allegheny	Slight	Slight	Slight	Moderate: slope.	Slight	Slight.
AtF*:						
Alticrest	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.
Totz	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
Helechawa	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Bo: Bonnie	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, wetness.	Severe: wetness.
CgF*:						
Cloverlick	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, slope.
Guyandotte	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, small stones.
Highsplint	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, large stones, slope.
Cr*:						
Craigsville	Severe: cutbanks cave, large stones.	Severe: flooding, large stones.	Severe: flooding, large stones.	Severe: flooding, large stones.	Severe: flooding, large stones.	Moderate: flooding, large stones.
Philo	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
CsC: Crossville	Severe: depth to rock, cutbanks cave.	Moderate: depth to rock, slope.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.
CsD: Crossville	Severe: depth to rock, cutbanks cave, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Du*. Dumps, mine; tailings; and tipples						
FbC*:						
Fairpoint	Moderate: large stones, slope.	Severe: unstable fill.	Severe: unstable fill.	Severe: slope, unstable fill.	Severe: unstable fill.	Severe: small stones, droughty.
Bethesda	Moderate: dense layer, large stones, slope.	Severe: unstable fill.	Severe: unstable fill.	Severe: slope, unstable fill.	Severe: unstable fill.	Severe: small stones, droughty.
FbF*:						
Fairpoint	Severe: slope.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: small stones, droughty, slope.
Bethesda	Severe: slope.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: small stones, droughty, slope.
GsC*:						
Gilpin	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: slope.	Moderate: depth to rock, slope.
Shelocta	Moderate: slope.	Moderate: slope.	Moderate: slope.	Moderate: slope.	Moderate: slope.	Moderate: slope.
GsD*:						
Gilpin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Shelocta	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
GtF*:						
Gilpin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Shelocta	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sequoia	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
HeF*:						
Helechawa	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Varilla	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
HeF*:						
Jefferson	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
HgD Highsplint	Moderate: depth to rock, large stones, slope.	Moderate: slope, large stones.	Moderate: depth to rock, slope, large stones.	Severe: slope.	Moderate: slope, large stones.	Severe: small stones, large stones.
HsF*:						
Highsplint	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, large stones, slope.
Cloverlick	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, small stones.
Guyandotte	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, small stones, large stones.
JfD Jefferson	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
KmD Kimper	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: small stones.
KrF*:						
Kimper	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, slope.
Renox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sharondale	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, large stones, slope.
Ph Philo	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.	Moderate: flooding, wetness.
Po Pope	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Sb Shelbiana	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
SeB Shelocta	Slight	Slight	Slight	Moderate: slope.	Slight	Moderate: small stones.
SeC Shelocta	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
SgE*:						
Shelocta----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Gilpin-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
ShF*:						
Shelocta----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Highsplint--------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, large stones, slope.
SkF*:						
Shelocta----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Kimper-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, slope.
Cloverlick--------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, small stones.
SmF*:						
Shelocta----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Kimper-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, slope.
Cutshin----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ud*, UrC*, UrE*. Udorthents-Urban land						
VrD--------------- Varilla	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: depth to rock, slope, large stones.	Severe: slope.	Moderate: slope, large stones.	Severe: large stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AgB----------------- Allegheny	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
AtF*:					
Alticrest----------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: depth to rock, slope.
Totz---------------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, slope.	Poor: depth to rock, seepage, slope.
Helechawa----------	Severe: slope.	Severe: seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope.	Poor: slope.
Bo------------------ Bonnie	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
CgF*:					
Cloverlick---------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
Guyandotte---------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
Highsplint---------	Severe: slope.	Severe: slope, seepage.	Severe: depth to rock, slope.	Severe: slope, seepage.	Poor: small stones, slope.
Cr*:					
Craigsville--------	Severe: flooding, poor filter, large stones.	Severe: seepage, flooding, large stones.	Severe: flooding, seepage, large stones.	Severe: flooding, seepage.	Poor: seepage, large stones.
Philo--------------	Severe: flooding, wetness, poor filter.	Severe: flooding, wetness, seepage.	Severe: flooding, depth to rock, seepage.	Severe: flooding, wetness.	Fair: wetness.
CsC----------------- Crossville	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
CsD----------------- Crossville	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
Du*. Dumps, mine; tailings; and tipples					
FbC*:					
Fairpoint----------	Severe: percs slowly, unstable fill.	Severe: slope, unstable fill.	Severe: unstable fill.	Severe: unstable fill.	Poor: small stones.
Bethesda-----------	Severe: percs slowly, unstable fill.	Severe: slope, unstable fill.	Severe: unstable fill.	Severe: unstable fill.	Poor: small stones.
FbF*:					
Fairpoint----------	Severe: percs slowly, slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Poor: small stones, slope.
Bethesda-----------	Severe: percs slowly, slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Poor: small stones, slope.
GsC*:					
Gilpin-------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Shelocta-----------	Moderate: percs slowly, slope.	Severe: slope.	Severe: depth to rock.	Moderate: slope, depth to rock.	Fair: small stones, too clayey, slope.
GsD*:					
Gilpin-------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Poor: slope, depth to rock.
Shelocta-----------	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope.
GtF*:					
Gilpin-------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Poor: slope, depth to rock.
Shelocta-----------	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, depth to rock.	Severe: slope.	Poor: small stones, slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
GtF*:					
Sequoia	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: depth to rock, too clayey, slope.
HeF*:					
Helechawa	Severe: slope.	Severe: seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope.	Poor: slope.
Varilla	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope.	Poor: large stones, slope.
Jefferson	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
HgD: Highsplint	Moderate: depth to rock, percs slowly, slope.	Severe: slope, seepage.	Severe: depth to rock.	Severe: seepage.	Poor: small stones.
HsF*:					
Highsplint	Severe: slope.	Severe: slope, seepage.	Severe: depth to rock, slope.	Severe: slope, seepage.	Poor: small stones, slope.
Cloverlick	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
Guyandotte	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
JfD: Jefferson	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
KmD: Kimper	Moderate: percs slowly, slope.	Severe: slope.	Severe: depth to rock.	Moderate: depth to rock, slope.	Poor: small stones.
KrF*:					
Kimper	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: small stones, slope.
Renox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
Sharondale	Severe: slope.	Severe: seepage, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: small stones, slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ph------------------ Philo	Severe: flooding, wetness, poor filter.	Severe: flooding, wetness, seepage.	Severe: flooding, depth to rock, seepage.	Severe: flooding, wetness.	Fair: wetness.
Po------------------ Pope	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
Sb------------------ Shelbiana	Severe: flooding.	Severe: flooding.	Severe: flooding, seepage.	Severe: flooding.	Fair: too clayey.
SeB----------------- Shelocta	Moderate: percs slowly.	Moderate: slope, depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Fair: small stones, too clayey.
SeC----------------- Shelocta	Moderate: percs slowly, slope.	Severe: slope.	Severe: depth to rock.	Moderate: slope, depth to rock.	Fair: small stones, too clayey, slope.
SgE*:					
Shelocta-----------	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope.
Gilpin-------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Poor: slope, depth to rock.
ShF*:					
Shelocta-----------	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope.
Highsplint---------	Severe: slope.	Severe: slope, seepage.	Severe: depth to rock, slope.	Severe: slope, seepage.	Poor: small stones, slope.
SkF*:					
Shelocta-----------	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope.
Kimper-------------	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: small stones, slope.
Cloverlick---------	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: small stones, slope.
SmF*:					
Shelocta-----------	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope.
Kimper-------------	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: small stones, slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
SmF*:					
Cutshin------------	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope.
Ud*, UrC*, UrE*. Udorthents-Urban land					
VrD----------------- Varilla	Severe: poor filter.	Severe: seepage, slope, large stones.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: large stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
AgB: Allegheny	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
AtF*:				
Alticrest	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Totz	Poor: depth to rock, slope.	Improbable: thin layer.	Improbable: too sandy.	Poor: depth to rock, small stones, slope.
Helechawa	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Bo: Bonnie	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
CgF*:				
Cloverlick	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Guyandotte	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Highsplint	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Cr*:				
Craigsville	Poor: large stones.	Improbable: large stones.	Improbable: large stones.	Poor: large stones, area reclaim.
Philo	Fair: wetness, depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
CsC: Crossville	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too clayey.
CsD: Crossville	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Du*. Dumps, mine; tailings; and tipples				
FbC*:				
Fairpoint	Fair: large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Bethesda	Fair: large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
FbF*:				
Fairpoint	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Bethesda	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
GsC*:				
Gilpin	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Shelocta	Fair: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
GsD*:				
Gilpin	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, small stones.
Shelocta	Fair: slope, depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
GtF*:				
Gilpin	Poor: slope, depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, small stones.
Shelocta	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Sequoia	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
HeF*:				
Helechawa	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Varilla	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, area reclaim, slope.
Jefferson	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
HgD: Highsplint	Fair: depth to rock, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
HsF*:				
Highsplint	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Cloverlick	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Guyandotte	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, area reclaim, slope.
JfD: Jefferson	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
KmD: Kimper	Fair: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
KrF*:				
Kimper	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Renox	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Sharondale	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ph: Philo	Fair: wetness, depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
Po: Pope	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Sb: Shelbiana	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
SeB, SeC: Shelocta	Fair: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
SgE*:				
Shelocta	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Gilpin	Poor: slope, depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, small stones.
ShF*:				
Shelocta	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Highsplint	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
SkF*:				
Shelocta	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Kimper	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Cloverlick	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
SmF*:				
Shelocta	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
SmF*:				
Kimper	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Cutshin	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Ud*, UrC*, UrE*. Udorthents-Urban land				
VrD Varilla	Fair: depth to rock, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, area reclaim.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
AgB: Allegheny	Moderate: seepage, slope.	Severe: piping.	Deep to water	Favorable	Favorable.
AtF*:					
Alticrest	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock.
Totz	Severe: depth to rock, slope.	Severe: seepage, piping.	Deep to water	Slope, depth to rock, too sandy.	Slope, droughty, depth to rock.
Helechawa	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope	Slope, droughty.
Bo: Bonnie	Slight	Severe: wetness.	Flooding	Erodes easily, wetness.	Wetness, erodes easily.
CgF*:					
Cloverlick	Severe: slope.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope.
Guyandotte	Severe: slope.	Severe: piping.	Deep to water	Slope, large stones.	Slope, large stones.
Highsplint	Severe: slope, seepage.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope, droughty.
Cr*:					
Craigsville	Severe: seepage.	Severe: seepage, large stones.	Deep to water	Large stones, too sandy.	Large stones, droughty.
Philo	Severe: seepage.	Severe: piping.	Flooding	Wetness	Favorable.
CsC: Crossville	Moderate: seepage, depth to rock.	Severe: piping.	Deep to water	Depth to rock	Depth to rock.
CsD: Crossville	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock.
Du*. Dumps, mine; tailings; and tipples					

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
FbC*:					
Fairpoint	Severe: slope.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope, droughty.
Bethesda	Severe: slope.	Severe: seepage, piping.	Deep to water	Slope, large stones.	Large stones, slope, droughty.
FbF*:					
Fairpoint	Severe: slope.	Severe: piping.	Deep to water	Slope, large stones, slippage.	Large stones, slope, droughty.
Bethesda	Severe: slope.	Severe: seepage, piping.	Deep to water	Slope, large stones, slippage.	Large stones, slope, droughty.
GsC*:					
Gilpin	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, large stones, slope.	Depth to rock, large stones, slope.
Shelocta	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Slope.
GsD*:					
Gilpin	Severe: slope.	Severe: thin layer.	Deep to water	Slope, depth to rock, large stones.	Slope, depth to rock, large stones.
Shelocta	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope.
GtF*:					
Gilpin	Severe: slope.	Severe: thin layer.	Deep to water	Slope, depth to rock, large stones.	Slope, depth to rock, large stones.
Shelocta	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope	Slope.
Sequoia	Severe: slope.	Severe: hard to pack, thin layer.	Deep to water	Slope, depth to rock.	Slope, depth to rock.
HeF*:					
Helechawa	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope	Slope, droughty.
Varilla	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, large stones, too sandy.	Large stones, slope, droughty.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
HeF*:					
Jefferson	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope	Slope.
HgD Highsplint	Severe: slope.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope, droughty.
HsF*:					
Highsplint	Severe: slope, seepage.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope, droughty.
Cloverlick	Severe: slope.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope.
Guyandotte	Severe: slope.	Severe: piping, large stones.	Deep to water	Slope, large stones.	Slope, large stones.
JfD Jefferson	Severe: seepage.	Severe: piping.	Deep to water	Slope	Slope.
KmD Kimper	Severe: slope.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope.
KrF*:					
Kimper	Severe: slope.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope.
Renox	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope.
Sharondale	Severe: seepage, slope.	Severe: large stones.	Deep to water	Slope, large stones.	Large stones, slope.
Ph Philo	Moderate: seepage, depth to rock.	Severe: piping.	Flooding	Wetness	Favorable.
Po Pope	Severe: seepage.	Severe: piping.	Deep to water	Favorable	Favorable.
Sb Shelbiana	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable.
SeB Shelocta	Moderate: seepage, slope, depth to rock.	Severe: piping.	Deep to water	Favorable	Favorable.
SeC Shelocta	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
SgE*:					
Shelocta	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope.
Gilpin	Severe: slope.	Severe: thin layer.	Deep to water	Slope, depth to rock, large stones.	Slope, depth to rock, large stones.
ShF*:					
Shelocta	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope.
Highsplint	Severe: slope, seepage.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope, droughty.
SkF*:					
Shelocta	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope.
Kimper	Severe: slope.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope.
Cloverlick	Severe: slope.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope.
SmF*:					
Shelocta	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope.
Kimper	Severe: slope.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope.
Cutshin	Severe: slope.	Severe: piping.	Deep to water	Slope, large stones.	Large stones, slope, droughty.
Ud*, UrC*, UrE*. Udorthents-Urban land					
VrD Varilla	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Slope, large stones, too sandy.	Large stones, slope, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
AgB-------------- Allegheny	0-7	Loam-------------	ML, CL	A-4	0	90-100	80-100	65-100	55-95	<35	NP-10
	7-39	Clay loam, loam, sandy clay loam.	ML, CL, SM, SC	A-4, A-6	0	90-100	80-100	65-95	35-80	<35	NP-15
	39-60	Clay loam, sandy loam, gravelly sandy loam.	SM, GC, ML, CL	A-4, A-6, A-2, A-1	0-5	65-100	55-100	35-95	20-75	<35	NP-15
AtF*: Alticrest-------	0-2	Fine sandy loam	ML, CL-ML, SM, SM-SC	A-4, A-2	0-2	80-100	75-100	55-80	34-65	<20	NP-6
	2-33	Sandy loam, loam, fine sandy loam.	ML, CL-ML, SM, SM-SC	A-4, A-2	0-2	80-100	75-100	55-85	34-70	<23	NP-6
	33	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Totz------------	0-7	Fine sandy loam	SM, SM-SC, SP-SM	A-4, A-2, A-3	0-15	75-100	50-100	50-90	5-40	<25	NP-5
	7-18	Loamy fine sand, loamy sand, gravelly loamy fine sand.	SM, SP-SM	A-2, A-3	0-15	75-100	50-100	50-90	5-35	<20	NP
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Helechawa-------	0-5	Sandy loam-------	SM, SM-SC, SC	A-2, A-4	0-10	85-100	85-100	70-90	25-45	<20	NP-10
	5-49	Sandy loam, fine sandy loam, gravelly loam.	SM, SM-SC, SC	A-2, A-4	0-5	85-100	85-100	70-90	25-45	<30	NP-10
	49-63	Loamy sand, gravelly sandy loam, sandy loam.	SM, SM-SC, SC	A-2	0-10	85-100	70-95	70-90	15-30	<20	NP-10
	63	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bo--------------- Bonnie	0-4	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	90-100	27-34	8-12
	4-24	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	90-100	27-34	8-12
	24-60	Silt loam, silty clay loam.	CL	A-4, A-6	0	100	100	90-100	80-100	25-39	8-15
CgF*: Cloverlick------	0-6	Gravelly loam----	CL, CL-ML, SC, SM-SC	A-4, A-6, A-7	5-10	50-90	40-85	40-80	35-70	25-45	5-20
	6-22	Gravelly loam, gravelly silt loam, flaggy loam.	ML, CL-ML, SM, SM-SC	A-4, A-6, A-7	5-20	50-90	40-85	40-85	35-70	15-35	3-15
	22-41	Very gravelly loam, very gravelly silt loam, very flaggy loam.	ML, CL-ML, SM, SM-SC	A-2, A-4, A-6	5-35	50-80	40-75	35-70	30-70	15-35	3-15
	41-70	Very flaggy loam, extremely flaggy loam, extremely flaggy silt loam.	SM, SM-SC, GM, GM-GC	A-2, A-4, A-6	10-40	40-90	40-80	30-70	30-70	15-35	3-15

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
CgF*:											
Guyandotte------	0-17	Very channery loam.	GM-GC, SM-SC, CL-ML, ML	A-1, A-2, A-4	5-20	30-70	25-65	20-60	15-55	20-30	NP-8
	17-61	Very channery sandy loam, very channery loam, extremely channery sandy loam.	GM-GC, SM-SC, CL-ML, ML	A-1, A-2, A-4	5-35	25-65	20-60	15-55	10-55	20-30	NP-8
Highsplint------	0-13	Very channery loam.	CL-ML, ML, GM-GC, SM-SC	A-2, A-4, A-6	5-35	45-80	40-70	35-65	30-60	15-35	3-15
	13-30	Very channery silt loam, very channery silty clay loam.	CL-ML, CL, GC, SC	A-4, A-6, A-7-6	5-35	45-75	40-70	40-70	35-65	25-45	5-20
	30-60	Very channery loam, very channery silty clay loam.	CL-ML, GM-GC, SM-SC, CL	A-2, A-4, A-6, A-7-6	5-35	45-75	40-70	40-70	30-65	20-45	5-20
Cr*:											
Craigsville-----	0-9	Gravelly fine sandy loam.	ML, SM, CL-ML, SC	A-2, A-4	0-25	65-90	60-85	40-75	25-60	<25	NP-10
	9-20	Gravelly sandy loam, cobbly loam, very gravelly sandy loam.	SM, GM, GC, SC	A-1, A-2, A-4	25-60	50-80	30-65	25-60	15-40	<25	NP-10
	20-60	Very gravelly loamy sand, very gravelly sandy loam, very cobbly loamy sand.	GC, GM, GP-GM, GM-GC	A-1, A-2	35-75	35-55	30-50	20-45	10-25	<25	NP-8
Philo-----------	0-9	Fine sandy loam	ML, SM, CL-ML	A-4	0-5	95-100	75-100	60-70	30-40	20-35	1-10
	9-60	Silt loam, loam, sandy loam.	ML, SM, CL-ML	A-4	0-5	95-100	75-100	70-90	45-80	20-35	1-10
CsC------------- Crossville	0-7	Loam-------------	ML, CL-ML, SM, SM-SC	A-4	0-2	90-100	85-100	70-85	36-75	<25	NP-7
	7-24	Loam, clay loam, sandy clay loam.	CL, CL-ML, SM-SC, SC	A-4, A-6, A-2	0-2	90-100	85-100	75-90	30-70	16-35	4-13
	24-37	Weathered bedrock	---	---	---	---	---	---	---	---	---
	37	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
CsD------------- Crossville	0-8	Loam-------------	ML, CL-ML, SM, SM-SC	A-4	0-2	90-100	85-100	70-85	36-75	<25	NP-7
	8-28	Loam, clay loam, sandy clay loam.	CL, CL-ML, SM-SC, SC	A-4, A-6, A-2	0-2	90-100	85-100	75-90	30-70	16-35	4-13
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Du*. Dumps, mine; tailings; and tipples											

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
FbC*:											
Fairpoint	0-3	Channery silt loam.	CL, CL-ML, SC, GC	A-4, A-6, A-2	5-15	55-90	45-80	40-80	30-75	25-40	4-14
	3-60	Channery clay loam, very channery silty clay loam.	GC, CL, CL-ML, SC	A-4, A-6, A-7, A-2	15-30	55-75	25-65	20-65	15-60	25-50	4-24
Bethesda	0-7	Very channery loam.	GC, SC	A-6, A-7, A-2	5-25	55-70	35-50	30-50	25-45	35-50	12-24
	7-60	Very channery clay loam, very channery silty clay loam, channery clay loam.	GM-GC, ML, CL, GM	A-4, A-6, A-7, A-2	10-30	45-80	25-65	25-65	20-60	24-50	3-23
FbF*:											
Fairpoint	0-11	Very channery silt loam.	CL, CL-ML, SC, GC	A-4, A-6, A-2	5-15	55-90	45-80	40-80	30-75	25-40	4-14
	11-60	Channery clay loam, very channery silty clay loam.	GC, CL, CL-ML, SC	A-4, A-6, A-7, A-2	15-30	55-75	25-65	20-65	15-60	25-50	4-24
Bethesda	0-5	Very channery loam.	GC, SC	A-6, A-7, A-2	5-25	55-70	35-50	30-50	25-45	35-50	12-24
	5-60	Very channery clay loam, very channery silty clay loam, channery clay loam.	GM-GC, ML, CL, GM	A-4, A-6, A-7, A-2	10-30	45-80	25-65	25-65	20-60	24-50	3-23
GsC*:											
Gilpin	0-8	Silt loam	CL, CL-ML	A-4, A-6	0-5	80-95	75-90	70-85	65-80	20-40	4-15
	8-26	Channery loam, channery silt loam, silty clay loam.	GC, SC, CL, CL-ML	A-2, A-4, A-6	0-30	50-95	45-90	35-85	30-80	20-40	4-15
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Shelocta	0-9	Silt loam	ML, CL-ML	A-4	0-5	80-95	75-95	60-95	55-90	<35	NP-10
	9-60	Silty clay loam, silt loam, channery silty clay loam.	CL, CL-ML, GC, SC	A-6, A-4	0-10	55-95	50-95	45-95	40-90	25-40	4-15
GsD*:											
Gilpin	0-6	Silt loam	CL, CL-ML	A-4, A-6	0-5	80-95	75-90	70-85	65-80	20-40	4-15
	6-28	Channery loam, channery silt loam, silty clay loam.	GC, SC, CL, CL-ML	A-2, A-4, A-6	0-30	50-95	45-90	35-85	30-80	20-40	4-15
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
GsD*:											
Shelocta--------	0-12	Silt loam--------	ML, CL-ML	A-4	0-5	80-95	75-95	60-95	55-90	<35	NP-10
	12-48	Silty clay loam, silt loam, channery silty clay loam.	CL, CL-ML, GC, SC	A-6, A-4	0-10	55-95	50-95	45-95	40-90	25-40	4-15
	48	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
GtF*:											
Gilpin----------	0-9	Loam-------------	CL, CL-ML	A-4, A-6	0-5	80-95	75-90	70-85	65-80	20-40	4-15
	9-36	Channery loam, channery silt loam, silty clay loam.	GC, SC, CL, CL-ML	A-2, A-4, A-6	0-30	50-95	45-90	35-85	30-80	20-40	4-15
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Shelocta--------	0-8	Silt loam--------	ML, CL-ML	A-4	0-5	80-95	75-95	60-95	55-90	<35	NP-10
	8-34	Silty clay loam, silt loam, channery silty clay loam.	CL, CL-ML, GC, SC	A-6, A-4	0-10	55-95	50-95	45-95	40-90	25-40	4-15
	34-55	Channery silt loam, channery silty clay loam, very channery clay loam.	GM, GC, ML, CL	A-4, A-6, A-2, A-1-b	0-15	40-85	35-70	25-70	20-65	20-40	3-20
	55	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sequoia---------	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-100	80-95	23-35	5-15
	8-32	Silty clay, clay, channery silty clay.	CL, MH, CH	A-7	0	70-100	65-100	60-100	55-95	43-74	20-40
	32-48	Weathered bedrock	---	---	---	---	---	---	---	---	---
	48	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
HeF*:											
Helechawa-------	0-6	Fine sandy loam	SM, SM-SC, SC	A-2, A-4	0-10	85-100	85-100	70-90	25-45	<20	NP-10
	6-49	Sandy loam, fine sandy loam, gravelly loam.	SM, SM-SC, SC	A-2, A-4	0-5	85-100	85-100	70-90	25-45	<30	NP-10
	49	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
HeF*:											
Varilla	0-3	Gravelly fine sandy loam.	SM, GM, SM-SC, GM-GC	A-2, A-4, A-6	0-10	60-85	60-85	50-80	25-50	<30	NP-15
	3-10	Gravelly fine sandy loam, gravelly sandy loam, gravelly loam.	SM, GM, SM-SC, GM-GC	A-2, A-4, A-6	0-10	60-85	60-85	50-80	25-50	<30	NP-15
	10-34	Very cobbly fine sandy loam, very gravelly fine sandy loam, very gravelly loam.	SM, SC, SM-SC	A-2, A-4, A-6	20-40	70-90	70-90	50-80	25-50	<30	NP-15
	34-64	Extremely cobbly fine sandy loam, extremely cobbly loamy sand, extremely gravelly loamy sand.	GM, GM-GC, SM, SM-SC	A-2	30-50	60-80	55-80	50-70	10-35	<25	NP-10
Jefferson	0-6	Loam	SM, SC, ML, CL	A-2, A-4	0-5	85-95	80-90	40-80	25-65	20-35	2-10
	6-36	Gravelly loam, gravelly clay loam, gravelly sandy clay loam.	SM, SC, ML, CL	A-4, A-2, A-6	0-5	75-90	50-90	50-80	30-70	15-35	2-15
	36-60	Very gravelly loam, very gravelly clay loam, very gravelly sandy clay loam.	GM, SM, ML, GM-GC	A-2, A-4, A-1	0-5	55-75	25-75	20-70	10-60	20-35	2-10
HgD Highsplint	0-11	Very flaggy silt loam.	CL-ML, ML, GM-GC, SM-SC	A-2, A-4, A-6	5-35	45-80	40-70	35-65	30-60	15-35	3-15
	11-48	Very channery silt loam, very channery silty clay loam.	CL-ML, CL, GC, SC	A-4, A-6, A-7-6	5-35	45-75	40-70	40-70	35-65	25-45	5-20
	48-60	Very channery loam, very channery silty clay loam.	CL-ML, GM-GC, SM-SC, CL	A-2, A-4, A-6, A-7-6	5-35	45-75	40-70	40-70	30-65	20-45	5-20
HsF*:											
Highsplint	0-4	Very channery silt loam.	CL-ML, ML, GM-GC, SM-SC	A-2, A-4, A-6	5-35	45-80	40-70	35-65	30-60	15-35	3-15
	4-48	Very channery silt loam, very channery silty clay loam.	CL-ML, CL, GC, SC	A-4, A-6, A-7-6	5-35	45-75	40-70	40-70	35-65	25-45	5-20
	48-60	Very channery loam, very channery silty clay loam.	CL-ML, GM-GC, SM-SC, CL	A-2, A-4, A-6, A-7-6	5-35	45-75	40-70	40-70	30-65	20-45	5-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
HsF*:											
Cloverlick	0-11	Very flaggy loam	CL, CL-ML, SC, SM-SC	A-4, A-6, A-7	5-35	60-90	50-80	40-80	35-70	25-45	5-20
	11-45	Very gravelly loam, very gravelly silt loam, very flaggy loam.	ML, CL-ML, SM, SM-SC	A-2, A-4, A-6	5-35	50-80	40-75	35-70	30-70	15-35	3-15
	45-60	Very flaggy loam, extremely flaggy loam, extremely flaggy silt loam.	SM, SM-SC, GM, GM-GC	A-2, A-4, A-6	10-40	40-90	40-80	30-70	30-70	15-35	3-15
Guyandotte	0-13	Extremely flaggy silt loam.	GM-GC, SM-SC, CL-ML, ML	A-1, A-2, A-4	20-50	25-65	20-60	15-55	10-55	20-30	NP-8
	13-60	Very channery sandy loam, very channery loam, extremely channery sandy loam.	GM-GC, SM-SC, CL-ML, ML	A-1, A-2, A-4	5-35	25-65	20-60	15-55	10-55	20-30	NP-8
JfD Jefferson	0-9	Gravelly silt loam.	ML, CL, CL-ML	A-4, A-6	0-5	75-90	60-80	55-80	55-70	15-35	NP-10
	9-40	Gravelly loam, gravelly clay loam, gravelly sandy clay loam.	SM, SC, ML, CL	A-4, A-2, A-6	0-5	75-90	50-90	50-80	30-70	15-35	2-15
	40-75	Very gravelly loam, very gravelly clay loam, very gravelly sandy clay loam.	GM, SM, ML, GM-GC	A-2, A-4, A-1	0-5	55-75	25-75	20-70	10-60	20-35	2-10
KmD Kimper	0-7	Silt loam	ML, CL-ML, GM, SM	A-2-4, A-4, A-1-b	0-20	40-85	40-75	30-70	20-65	22-30	4-10
	7-48	Channery loam, channery silt loam, very channery loam.	ML, CL-ML, GM, CL	A-2-4, A-4	0-20	40-85	40-75	30-70	20-65	27-41	6-18
	48	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
KrF*:											
Kimper	0-8	Channery silt loam.	ML, CL-ML, GM, SM	A-2-4, A-4, A-1-b	0-20	40-85	40-75	30-70	20-65	22-30	4-10
	8-50	Channery loam, channery silt loam, very channery loam.	ML, CL-ML, GM, CL	A-2-4, A-4	0-20	40-85	40-75	30-70	20-65	27-41	6-18
	50	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
KrF*:											
Renox	0-11	Silt loam	ML, CL-ML, CL	A-4	0-5	90-100	85-95	80-90	70-90	<30	NP-10
	11-60	Gravelly loam, silt loam, gravelly sandy clay loam.	SC, ML, CL, GM	A-4, A-6, A-2	0-5	65-95	50-90	40-80	30-70	20-40	2-20
Sharondale	0-14	Gravelly silt loam.	SM-SC, SC, GM, SM	A-1, A-2-4, A-4	15-35	35-80	30-75	25-65	20-40	16-25	2-10
	14-60	Very channery loam, very flaggy loam, very flaggy fine sandy loam.	SM-SC, SC, GM, SM	A-1, A-2-4, A-4	10-40	30-70	25-65	20-60	10-40	16-25	2-10
Ph: Philo	0-9	Fine sandy loam	ML, SM, CL-ML	A-4	0-5	95-100	75-100	60-70	30-40	20-35	1-10
	9-37	Silt loam, loam, sandy loam.	ML, SM, CL-ML	A-4	0-5	95-100	75-100	70-90	45-80	20-35	1-10
	37-60	Stratified sand to silt loam.	GM, SM, ML, CL-ML	A-2, A-4	0-5	60-95	50-90	40-85	30-80	15-30	1-10
Po: Pope	0-4	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-2, A-4	0	85-100	75-100	51-85	25-55	<20	NP-5
	4-23	Fine sandy loam, sandy loam, loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0	95-100	80-100	51-95	25-75	<30	NP-7
	23-62	Sandy loam, loamy sand.	SM, SM-SC, ML, GM	A-2, A-1, A-4	0-20	45-100	35-100	30-95	15-70	<30	NP-7
Sb: Shelbiana	0-15	Loam	ML, CL, CL-ML	A-4	0	95-100	90-100	75-100	70-95	16-35	NP-10
	15-70	Loam, silt loam, clay loam.	ML, CL, CL-ML	A-4, A-6	0	95-100	90-100	75-100	65-95	16-40	3-15
SeB: Shelocta	0-7	Gravelly silt loam.	ML, GM, SM	A-4	0-10	55-95	50-80	40-70	36-65	<35	NP-10
	7-60	Silty clay loam, silt loam, channery silty clay loam.	CL, CL-ML, GC, SC	A-6, A-4	0-10	55-95	50-95	45-95	40-90	25-40	4-15
SeC: Shelocta	0-6	Gravelly silt loam.	ML, GM, SM	A-4	0-10	55-95	50-80	40-70	36-65	<35	NP-10
	6-60	Silty clay loam, silt loam, channery silty clay loam.	CL, CL-ML, GC, SC	A-6, A-4	0-10	55-95	50-95	45-95	40-90	25-40	4-15

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag-ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
SgE*:											
Shelocta	0-6	Silt loam	ML, CL-ML	A-4	0-5	80-95	75-95	60-95	55-90	<35	NP-10
	6-33	Silty clay loam, silt loam, channery silty clay loam.	CL, CL-ML, GC, SC	A-6, A-4	0-10	55-95	50-95	45-95	40-90	25-40	4-15
	33-58	Channery silt loam, channery silty clay loam, very channery clay loam.	GM, GC, ML, CL	A-4, A-6, A-2, A-1-b	0-15	40-85	35-70	25-70	20-65	20-40	3-20
	58	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Gilpin	0-6	Silt loam	CL, CL-ML	A-4, A-6	0-5	80-95	75-90	70-85	65-80	20-40	4-15
	6-26	Channery loam, channery silt loam, silty clay loam.	GC, SC, CL, CL-ML	A-2, A-4, A-6	0-30	50-95	45-90	35-85	30-80	20-40	4-15
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
ShF*:											
Shelocta	0-18	Gravelly loam	ML, GM, SM	A-4	0-10	55-95	50-80	40-70	36-65	<35	NP-10
	18-50	Silty clay loam, silt loam, channery silty clay loam.	CL, CL-ML, GC, SC	A-6, A-4	0-10	55-95	50-95	45-95	40-90	25-40	4-15
	50-60	Channery silt loam, channery silty clay loam, very channery clay loam.	GM, GC, ML, CL	A-4, A-6, A-2, A-1-b	0-15	40-85	35-70	25-70	20-65	20-40	3-20
Highsplint	0-14	Very channery loam.	CL-ML, ML, GM-GC, SM-SC	A-2, A-4, A-6	5-35	45-80	40-70	35-65	30-60	15-35	3-15
	14-30	Very channery silt loam, very channery silty clay loam.	CL-ML, CL, GC, SC	A-4, A-6, A-7-6	5-35	45-75	40-70	40-70	35-65	25-45	5-20
	30-60	Very channery loam, very channery silty clay loam.	CL-ML, GM-GC, SM-SC, CL	A-2, A-4, A-6, A-7-6	5-35	45-75	40-70	40-70	30-65	20-45	5-20
SkF*:											
Shelocta	0-8	Channery silt loam.	ML, GM, SM	A-4	0-10	55-95	50-80	40-70	36-65	<35	NP-10
	8-60	Silty clay loam, silt loam, channery silty clay loam.	CL, CL-ML, GC, SC	A-6, A-4	0-10	55-95	50-95	45-95	40-90	25-40	4-15

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
SkF*:											
Kimper----------	0-17	Silt loam--------	ML, CL-ML, GM, SM	A-2-4, A-4, A-1-b	0-20	40-85	40-75	30-70	20-65	22-30	4-10
	17-60	Channery loam, channery silt loam, very channery loam.	ML, CL-ML, GM, CL	A-2-4, A-4	0-20	40-85	40-75	30-70	20-65	27-41	6-18
Cloverlick------	0-7	Very gravelly loam.	CL, CL-ML, SC, SM-SC	A-4, A-6, A-7	5-35	60-90	50-80	40-80	35-70	25-45	5-20
	7-37	Very gravelly loam, very gravelly silt loam, very flaggy loam.	ML, CL-ML, SM, SM-SC	A-2, A-4, A-6	5-35	50-80	40-75	35-70	30-70	15-35	3-15
	37-60	Very flaggy loam, extremely flaggy loam, extremely flaggy silt loam.	SM, SM-SC, GM, GM-GC	A-2, A-4, A-6	10-40	40-90	40-80	30-70	30-70	15-35	3-15
SmF*:											
Shelocta--------	0-8	Silt loam--------	ML, CL-ML	A-4	0-5	80-95	75-95	60-95	55-90	<35	NP-10
	8-31	Silty clay loam, silt loam, channery silty clay loam.	CL, CL-ML, GC, SC	A-6, A-4	0-10	55-95	50-95	45-95	40-90	25-40	4-15
	31-55	Channery silt loam, channery silty clay loam, very channery clay loam.	GM, GC, ML, CL	A-4, A-6, A-2, A-1-b	0-15	40-85	35-70	25-70	20-65	20-40	3-20
	55	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Kimper----------	0-7	Channery silt loam.	ML, CL-ML, GM, SM	A-2-4, A-4, A-1-b	0-20	40-85	40-75	30-70	20-65	22-30	4-10
	7-48	Channery loam, channery silt loam, very channery loam.	ML, CL-ML, GM, CL	A-2-4, A-4	0-20	40-85	40-75	30-70	20-65	27-41	6-18
	48-62	Very channery loam, very channery silt loam, very channery sandy loam.	ML, CL-ML, GM, CL	A-2-4, A-4, A-1-b	5-25	40-85	40-75	30-70	20-65	23-30	3-10
	62	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cutshin---------	0-17	Silt loam--------	ML, CL-ML	A-4, A-6, A-7	0-5	85-100	80-95	75-90	55-90	20-45	3-15
	17-60	Channery loam, gravelly loam, flaggy clay loam.	CL, ML, GC, SC	A-4, A-6, A-2, A-5	0-20	55-85	50-80	40-75	30-60	20-45	3-15

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ud*, UrC*, UrE*. Udorthents-Urban land											
VrD-------------- Varilla	0-5	Very stony loam	SM, SC, SM-SC	A-2, A-4, A-6	20-40	70-90	70-90	50-80	25-50	<30	NP-15
	5-31	Very cobbly fine sandy loam, very cobbly sandy loam, very cobbly loam.	GM, GM-GC, SM, SM-SC	A-2, A-4, A-6	20-50	60-85	60-85	50-80	25-50	<30	NP-15
	31-60	Extremely cobbly fine sandy loam, extremely cobbly loamy sand, extremely gravelly loamy sand.	GM, GM-GC, SM, SM-SC	A-2	30-50	60-80	55-80	50-70	10-35	<25	NP-10

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
AgB: Allegheny	0-7	15-27	1.20-1.40	0.6-2.0	0.12-0.22	3.6-5.5	Low	0.32	4	1-4
	7-39	18-35	1.20-1.50	0.6-2.0	0.13-0.18	3.6-5.5	Low	0.28		
	39-60	10-35	1.20-1.40	0.6-2.0	0.08-0.17	3.6-5.5	Low	0.28		
AtF*:										
Alticrest	0-2	8-18	1.40-1.55	2.0-6.0	0.12-0.18	4.5-5.5	Low	0.24	2	1-3
	2-33	8-18	1.40-1.55	2.0-6.0	0.10-0.16	4.5-5.5	Low	0.20		
	33	---	---	---	---	---	---	----		
Totz	0-7	3-12	1.15-1.35	6.0-20	0.07-0.12	3.6-5.5	Low	0.15	2	1-5
	7-18	3-12	1.50-1.70	6.0-20	0.05-0.11	3.6-5.5	Low	0.15		
	18	---	---	---	---	---	---	----		
Helechawa	0-5	4-15	1.10-1.40	2.0-6.0	0.10-0.18	3.6-6.5	Low	0.15	4	2-10
	5-49	7-18	1.35-1.70	2.0-6.0	0.08-0.14	3.6-5.5	Low	0.24		
	49-63	5-15	1.50-1.70	2.0-6.0	0.08-0.13	3.6-5.5	Low	0.15		
	63	---	---	---	---	---	---	----		
Bo: Bonnie	0-4	18-27	1.20-1.40	0.6-2.0	0.22-0.24	4.5-7.3	Low	0.43	5	1-3
	4-24	18-27	1.40-1.60	0.2-0.6	0.20-0.22	4.5-5.5	Low	0.43		
	24-60	18-27	1.45-1.65	0.2-0.6	0.18-0.20	4.5-5.5	Low	0.43		
CgF*:										
Cloverlick	0-6	18-27	1.00-1.20	0.6-2.0	0.20-0.24	3.6-6.5	Low	0.10	5	5-15
	6-22	15-30	1.10-1.30	0.6-2.0	0.18-0.24	3.6-5.5	Low	0.10		
	22-41	15-30	1.30-1.50	0.6-2.0	0.12-0.20	3.6-5.5	Low	0.10		
	41-70	15-30	1.30-1.60	0.6-2.0	0.05-0.12	3.6-5.5	Low	0.10		
Guyandotte	0-17	5-27	1.00-1.30	0.6-2.0	0.10-0.16	3.6-6.5	Low	0.10	5	2-10
	17-61	5-27	1.30-1.60	0.6-2.0	0.05-0.15	4.5-6.0	Low	0.17		
Highsplint	0-13	15-27	1.10-1.30	0.6-6.0	0.07-0.15	3.6-6.5	Low	0.17	4	.5-5
	13-30	18-34	1.30-1.55	0.6-6.0	0.07-0.13	3.6-5.5	Low	0.17		
	30-60	18-34	1.55-1.70	0.6-2.0	0.05-0.11	3.6-5.5	Low	0.17		
Cr*:										
Craigsville	0-9	5-15	1.20-1.40	2.0-6.0	0.07-0.15	4.5-5.5	Low	0.17	3	1-5
	9-20	5-15	1.30-1.60	2.0-6.0	0.06-0.15	4.5-5.5	Low	0.17		
	20-60	5-10	1.35-1.55	>6.0	0.04-0.09	4.5-5.5	Low	0.17		
Philo	0-9	10-18	1.20-1.40	2.0-6.0	0.10-0.14	4.5-6.0	Low	0.28	5	2-4
	9-60	5-18	1.20-1.40	0.6-2.0	0.10-0.20	4.5-6.0	Low	0.32		
CsC: Crossville	0-7	10-20	1.25-1.45	0.6-2.0	0.14-0.20	4.5-5.5	Low	0.28	2	2-4
	7-24	15-32	1.30-1.50	0.6-2.0	0.12-0.17	4.5-5.5	Low	0.20		
	24-37	---	---	---	---	---	---	----		
	37	---	---	---	---	---	---	----		
CsD: Crossville	0-8	10-20	1.25-1.45	0.6-2.0	0.14-0.20	4.5-5.5	Low	0.28	2	2-4
	8-28	15-32	1.30-1.50	0.6-2.0	0.12-0.17	4.5-5.5	Low	0.20		
	28	---	---	---	---	---	---	----		
Du*. Dumps, mine; tailings; and tipples										

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
FbC*:										
Fairpoint--------	0-3	18-27	1.40-1.55	0.6-2.0	0.09-0.18	5.6-7.3	Low-----------	0.28	5	<.5
	3-60	18-35	1.60-1.80	0.2-0.6	0.03-0.10	5.6-7.3	Low-----------	0.28		
Bethesda---------	0-7	18-27	1.45-1.65	0.2-0.6	0.04-0.10	3.6-5.5	Low-----------	0.28	5	<.5
	7-60	18-35	1.60-1.90	0.2-0.6	0.04-0.10	3.6-5.5	Low-----------	0.32		
FbF*:										
Fairpoint--------	0-11	18-27	1.40-1.55	0.6-2.0	0.09-0.18	5.6-7.3	Low-----------	0.28	5	<.5
	11-60	18-35	1.60-1.80	0.2-0.6	0.03-0.10	5.6-7.3	Low-----------	0.28		
Bethesda---------	0-5	18-27	1.45-1.65	0.2-0.6	0.04-0.10	3.6-5.5	Low-----------	0.28	5	<.5
	5-60	18-35	1.60-1.90	0.2-0.6	0.04-0.10	3.6-5.5	Low-----------	0.32		
GsC*:										
Gilpin-----------	0-8	15-27	1.20-1.40	0.6-2.0	0.12-0.18	4.5-5.5	Low-----------	0.32	3	.5-4
	8-26	18-35	1.20-1.50	0.6-2.0	0.12-0.16	4.5-5.5	Low-----------	0.24		
	26	---	---	---	---	---	--------------	----		
Shelocta---------	0-9	10-27	1.15-1.30	0.6-2.0	0.16-0.22	3.6-6.5	Low-----------	0.32	4	.5-5
	9-60	18-45	1.30-1.55	0.6-2.0	0.10-0.20	4.5-5.5	Low-----------	0.28		
GsD*:										
Gilpin-----------	0-6	15-27	1.20-1.40	0.6-2.0	0.12-0.18	4.5-5.5	Low-----------	0.32	3	.5-4
	6-28	18-35	1.20-1.50	0.6-2.0	0.12-0.16	4.5-5.5	Low-----------	0.24		
	28	---	---	---	---	---	--------------	----		
Shelocta---------	0-12	10-27	1.15-1.30	0.6-2.0	0.16-0.22	3.6-6.5	Low-----------	0.32	4	.5-5
	12-48	18-45	1.30-1.55	0.6-2.0	0.10-0.20	4.5-5.5	Low-----------	0.28		
	48	---	---	---	---	---	--------------	----		
GtF*:										
Gilpin-----------	0-9	15-27	1.20-1.40	0.6-2.0	0.12-0.18	4.5-5.5	Low-----------	0.32	3	.5-4
	9-36	18-35	1.20-1.50	0.6-2.0	0.12-0.16	4.5-5.5	Low-----------	0.24		
	36	---	---	---	---	---	--------------	----		
Shelocta---------	0-8	10-27	1.15-1.30	0.6-2.0	0.16-0.22	3.6-6.5	Low-----------	0.32	4	.5-5
	8-34	18-34	1.30-1.55	0.6-2.0	0.10-0.20	4.5-5.5	Low-----------	0.28		
	34-55	15-45	1.30-1.55	0.6-6.0	0.08-0.16	4.5-5.5	Low-----------	0.17		
	55	---	---	---	---	---	--------------	----		
Sequoia----------	0-8	15-27	1.30-1.50	0.6-2.0	0.17-0.20	4.5-5.5	Low-----------	0.37	3	.5-2
	8-32	35-60	1.35-1.55	0.2-0.6	0.08-0.16	4.5-5.5	Moderate------	0.24		
	32-48	---	---	---	---	---	--------------	----		
	48	---	---	---	---	---	--------------	----		
HeF*:										
Helechawa--------	0-6	4-15	1.10-1.40	2.0-6.0	0.10-0.18	3.6-6.5	Low-----------	0.15	4	2-10
	6-49	7-18	1.35-1.70	2.0-6.0	0.08-0.14	3.6-5.5	Low-----------	0.24		
	49	---	---	---	---	---	--------------	----		
Varilla----------	0-3	3-20	1.00-1.40	2.0-6.0	0.10-0.13	3.6-6.5	Low-----------	0.20	5	1-6
	3-10	3-20	1.35-1.55	2.0-6.0	0.10-0.13	3.6-5.5	Low-----------	0.20		
	10-34	3-20	1.45-1.65	2.0-6.0	0.05-0.10	3.6-5.5	Low-----------	0.10		
	34-64	3-20	1.45-1.65	2.0-20	0.01-0.05	3.6-5.5	Low-----------	0.10		
Jefferson--------	0-6	10-20	1.30-1.50	2.0-6.0	0.10-0.18	4.5-5.5	Low-----------	0.24	4	.5-5
	6-36	10-27	1.30-1.65	2.0-6.0	0.10-0.16	4.5-5.5	Low-----------	0.28		
	36-60	15-30	1.30-1.65	0.6-6.0	0.08-0.14	4.5-5.5	Low-----------	0.17		

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
HgD--------------- Highsplint	0-11	15-27	1.10-1.30	0.6-6.0	0.07-0.15	3.6-6.5	Low-----------	0.17	4	.5-5
	11-48	18-34	1.30-1.55	0.6-6.0	0.07-0.13	3.6-5.5	Low-----------	0.17		
	48-60	18-34	1.55-1.70	0.6-2.0	0.05-0.11	3.6-5.5	Low-----------	0.17		
HsF*:										
Highsplint-------	0-4	15-27	1.10-1.30	0.6-6.0	0.07-0.15	3.6-6.5	Low-----------	0.17	4	.5-5
	4-48	18-34	1.30-1.55	0.6-6.0	0.07-0.13	3.6-5.5	Low-----------	0.17		
	48-60	18-34	1.55-1.70	0.6-2.0	0.05-0.11	3.6-5.5	Low-----------	0.17		
Cloverlick-------	0-11	18-27	1.00-1.20	0.6-2.0	0.16-0.21	3.6-6.5	Low-----------	0.10	5	5-15
	11-45	15-30	1.30-1.50	0.6-2.0	0.12-0.20	3.6-5.5	Low-----------	0.10		
	45-60	15-30	1.30-1.60	0.6-2.0	0.05-0.12	3.6-5.5	Low-----------	0.10		
Guyandotte-------	0-13	5-27	1.00-1.30	0.6-2.0	0.10-0.16	3.6-6.5	Low-----------	0.10	5	2-10
	13-60	5-27	1.30-1.60	0.6-2.0	0.05-0.15	4.5-6.0	Low-----------	0.17		
JfD--------------- Jefferson	0-9	10-20	1.20-1.50	2.0-6.0	0.10-0.18	4.5-7.3	Low-----------	0.20	4	.5-5
	9-40	10-27	1.30-1.65	2.0-6.0	0.10-0.16	4.5-5.5	Low-----------	0.28		
	40-75	15-30	1.30-1.65	0.6-6.0	0.08-0.14	4.5-5.5	Low-----------	0.17		
KmD--------------- Kimper	0-7	12-27	1.00-1.40	0.6-2.0	0.15-0.22	4.1-6.5	Low-----------	0.17	4	2-15
	7-48	18-30	1.20-1.70	0.6-2.0	0.15-0.20	4.5-6.0	Low-----------	0.17		
	48	---	---	---	---	---	-------------	----		
KrF*:										
Kimper-----------	0-8	12-27	1.00-1.40	0.6-2.0	0.15-0.22	4.1-6.5	Low-----------	0.17	4	4-15
	8-50	18-30	1.20-1.70	0.6-2.0	0.15-0.20	4.5-6.0	Low-----------	0.17		
	50	---	---	---	---	---	-------------	----		
Renox------------	0-11	12-27	1.20-1.40	0.6-2.0	0.18-0.22	5.6-7.3	Low-----------	0.32	5	4-6
	11-60	18-35	1.20-1.45	0.6-2.0	0.10-0.16	5.6-7.3	Low-----------	0.17		
Sharondale-------	0-14	8-27	1.00-1.40	2.0-6.0	0.12-0.22	5.6-7.3	Low-----------	0.10	5	4-12
	14-60	8-30	1.20-1.70	2.0-6.0	0.12-0.20	5.6-7.3	Low-----------	0.17		
Ph---------------- Philo	0-9	10-18	1.20-1.40	2.0-6.0	0.10-0.14	4.5-6.0	Low-----------	0.28	5	2-4
	9-37	10-18	1.20-1.40	0.6-2.0	0.10-0.20	4.5-6.0	Low-----------	0.32		
	37-60	5-18	1.20-1.40	2.0-6.0	0.06-0.10	4.5-6.0	Low-----------	0.24		
Po---------------- Pope	0-4	5-15	1.20-1.40	2.0-6.0	0.10-0.16	4.5-5.5	Low-----------	0.28	5	1-4
	4-23	5-18	1.30-1.60	2.0-6.0	0.10-0.18	4.5-5.5	Low-----------	0.28		
	23-62	5-20	1.30-1.60	2.0-6.0	0.10-0.18	4.5-5.5	Low-----------	0.28		
Sb---------------- Shelbiana	0-15	10-27	1.20-1.40	0.6-2.0	0.12-0.22	4.5-6.0	Low-----------	0.28	5	2-6
	15-70	18-34	1.20-1.50	0.6-2.0	0.12-0.22	4.5-6.0	Low-----------	0.32		
SeB--------------- Shelocta	0-7	10-27	1.15-1.30	0.6-2.0	0.10-0.18	3.6-6.5	Low-----------	0.28	4	.5-5
	7-60	18-34	1.30-1.55	0.6-2.0	0.10-0.20	4.5-5.5	Low-----------	0.28		
SeC--------------- Shelocta	0-6	10-27	1.15-1.30	0.6-2.0	0.10-0.18	3.6-6.5	Low-----------	0.28	4	.5-5
	6-60	18-34	1.30-1.55	0.6-2.0	0.10-0.20	4.5-5.5	Low-----------	0.28		
SgE*:										
Shelocta---------	0-6	10-27	1.15-1.30	0.6-2.0	0.16-0.22	3.6-6.5	Low-----------	0.32	4	.5-5
	6-33	18-34	1.30-1.55	0.6-2.0	0.10-0.20	4.5-5.5	Low-----------	0.28		
	33-58	15-45	1.30-1.55	0.6-6.0	0.08-0.16	4.5-5.5	Low-----------	0.17		
	58	---	---	---	---	---	-------------	----		
Gilpin-----------	0-6	15-27	1.20-1.40	0.6-2.0	0.12-0.18	4.5-5.5	Low-----------	0.32	3	.5-4
	6-26	18-35	1.20-1.50	0.6-2.0	0.12-0.16	4.5-5.5	Low-----------	0.24		
	26	---	---	---	---	---	-------------	----		

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
ShF*:										
Shelocta---------	0-18	10-27	1.15-1.30	0.6-2.0	0.10-0.18	3.6-6.5	Low-----------	0.28	4	.5-5
	18-50	18-34	1.30-1.55	0.6-2.0	0.10-0.20	4.5-5.5	Low-----------	0.28		
	50-60	15-45	1.30-1.55	0.6-6.0	0.08-0.16	4.5-5.5	Low-----------	0.17		
Highsplint-------	0-14	15-27	1.10-1.30	0.6-6.0	0.07-0.15	3.6-6.5	Low-----------	0.17	4	.5-5
	14-30	18-34	1.30-1.55	0.6-6.0	0.07-0.13	3.6-5.5	Low-----------	0.17		
	30-60	18-34	1.55-1.70	0.6-2.0	0.05-0.11	3.6-5.5	Low-----------	0.17		
SkF*:										
Shelocta---------	0-8	10-27	1.15-1.30	0.6-2.0	0.10-0.18	3.6-6.5	Low-----------	0.28	4	.5-5
	8-60	18-45	1.30-1.55	0.6-2.0	0.10-0.20	4.5-5.5	Low-----------	0.28		
Kimper-----------	0-17	12-27	1.00-1.40	0.6-2.0	0.15-0.22	4.1-6.5	Low-----------	0.17	4	2-15
	17-60	18-30	1.20-1.70	0.6-2.0	0.15-0.20	4.5-6.0	Low-----------	0.17		
Cloverlick-------	0-7	18-27	1.00-1.20	0.6-2.0	0.16-0.21	3.6-6.5	Low-----------	0.10	5	5-15
	7-37	15-30	1.30-1.50	0.6-2.0	0.12-0.20	3.6-5.5	Low-----------	0.10		
	37-60	15-30	1.30-1.60	0.6-2.0	0.05-0.12	3.6-5.5	Low-----------	0.10		
SmF*:										
Shelocta---------	0-8	10-25	1.15-1.30	0.6-2.0	0.16-0.22	3.6-6.5	Low-----------	0.32	4	.5-5
	8-31	18-34	1.30-1.55	0.6-2.0	0.10-0.20	4.5-5.5	Low-----------	0.28		
	31-55	15-34	1.30-1.55	0.6-6.0	0.08-0.16	4.5-5.5	Low-----------	0.17		
	55	---	---	---	---	---	-------------	----		
Kimper-----------	0-7	12-27	1.00-1.40	0.6-2.0	0.15-0.22	4.1-6.5	Low-----------	0.17	4	2-15
	7-48	18-30	1.20-1.70	0.6-2.0	0.15-0.20	4.5-6.0	Low-----------	0.17		
	48-62	12-20	1.20-1.70	0.6-6.0	0.15-0.20	4.5-6.0	Low-----------	0.17		
	62	---	---	---	---	---	-------------	----		
Cutshin----------	0-17	12-27	1.20-1.40	0.6-2.0	0.10-0.18	4.1-6.5	Low-----------	0.32	4	3-7
	17-60	12-27	1.20-1.40	0.6-2.0	0.08-0.16	4.5-5.5	Low-----------	0.28		
Ud*, UrC*, UrE*. Udorthents-Urban land										
VrD-------------- Varilla	0-5	3-20	1.00-1.40	2.0-6.0	0.05-0.10	3.6-6.5	Low-----------	0.10	4	1-6
	5-31	3-20	1.45-1.65	2.0-6.0	0.05-0.10	3.6-5.5	Low-----------	0.10		
	31-60	3-20	1.45-1.65	2.0-20.0	0.01-0.05	3.6-5.5	Low-----------	0.10		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "occasional," "brief," and "apparent" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In			
AgB---------------- Allegheny	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	High.
AtF*:											
Alticrest---------	B	None---------	---	---	>6.0	---	---	20-40	Hard	Low-------	High.
Totz--------------	D	None---------	---	---	>6.0	---	---	10-20	Hard	Low-------	High.
Helechawa---------	B	None---------	---	---	>6.0	---	---	>40	Hard	Low-------	High.
Bo----------------- Bonnie	C/D	Occasional	Brief------	Jan-Jun	0-1.0	Apparent	Jan-Jun	>60	---	High------	High.
CgF*:											
Cloverlick--------	B	None---------	---	---	>6.0	---	---	>48	Hard	Low-------	High.
Guyandotte--------	B	None---------	---	---	>6.0	---	---	>72	---	Low-------	High.
Highsplint--------	B	None---------	---	---	>6.0	---	---	>48	Hard	Low-------	High.
Cr*:											
Craigsville-------	B	Occasional	Very brief	Dec-Jun	>4.0	Apparent	Jan-Mar	>60	---	Low-------	Moderate.
Philo-------------	B	Occasional	Very brief	Dec-May	1.5-3.0	Apparent	Dec-Apr	>48	Hard	Low-------	High.
CsC, CsD----------- Crossville	B	None---------	---	---	>6.0	---	---	20-40	Hard	Low-------	High.
Du*. Dumps, mine; tailings; and tipples											
FbC*, FbF*:											
Fairpoint---------	C	None---------	---	---	>6.0	---	---	>60	---	High------	Moderate.
Bethesda----------	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	High.
GsC*, GsD*:											
Gilpin------------	C	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	High.
Shelocta----------	B	None---------	---	---	>6.0	---	---	>48	Hard	Low-------	High.
GtF*:											
Gilpin------------	C	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	High.
Shelocta----------	B	None---------	---	---	>6.0	---	---	>48	Hard	Low-------	High.
Sequoia-----------	C	None---------	---	---	>6.0	---	---	20-40	Soft	High------	Moderate.
HeF*:											
Helechawa---------	B	None---------	---	---	>6.0	---	---	>40	Hard	Low-------	High.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hard-ness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In			
HeF*:											
Varilla----------	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	High.
Jefferson--------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High.
HgD--------------- Highsplint	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	High.
HsF*:											
Highsplint-------	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	High.
Cloverlick-------	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	High.
Guyandotte-------	B	None--------	---	---	>6.0	---	---	>72	---	Low------	High.
JfD--------------- Jefferson	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High.
KmD--------------- Kimper	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	Moderate.
KrF*:											
Kimper-----------	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	Moderate.
Renox------------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
Sharondale-------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate.
Ph---------------- Philo	B	Occasional	Brief-----	Dec-May	1.5-3.0	Apparent	Dec-Apr	>48	Hard	Low------	High.
Po---------------- Pope	B	Occasional	Brief-----	Nov-Apr	>6.0	---	---	>60	---	Low------	High.
Sb---------------- Shelbiana	B	Occasional	Brief-----	Dec-Jun	>6.0	---	---	>60	---	Low------	Moderate.
SeB, SeC---------- Shelocta	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	High.
SgE*:											
Shelocta---------	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	High.
Gilpin-----------	C	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	High.
ShF*:											
Shelocta---------	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	High.
Highsplint-------	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	High.
SkF*:											
Shelocta---------	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	High.
Kimper-----------	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	Moderate.
Cloverlick-------	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	High.
SmF*:											
Shelocta---------	B	None--------	---	---	>6.0	---	---	>48	Hard	Low------	High.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro- logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard- ness	Uncoated steel	Concrete
					Ft			In			
SmF*:											
Kimper	B	None	---	---	>6.0	---	---	>48	Hard	Low	Moderate.
Cutshin	B	None	---	---	>6.0	---	---	>40	Soft	Low	Low.
Ud*, UrC*, UrE*. Udorthents-Urban land											
VrD Varilla	B	None	---	---	>6.0	---	---	>48	Hard	Low	High.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--PHYSICAL ANALYSIS OF SELECTED SOILS

(The symbol < means less than; > means more than. Dashes indicate that the material was not detected. TR indicates trace amounts. The pedons for the soils listed are typical of the series in the survey area. For the location of the pedons, see the section "Soil Series and Their Morphology")

Soil name, report number, horizon, and depth in inches	Total-- Clay (<0.002 mm)	Silt (0.05-0.002 mm)	Sand (2-0.05 mm)	Size class and particle diameter (mm) Very fine (0.1-0.05)	Fine (0.25-0.1)	Medium (0.5-0.25)	Coarse (1-0.5)	Very coarse (2-1)	Rock fragments 2-20 mm	>2 mm	Textural class*
	Pct <2 mm								Pct	Pct	
Cloverlick gravelly loam: (85KY-095-3)											
A----- 0 to 6	24.2	38.3	37.5	6.9	9.1	7.3	5.8	8.4	32	32	grl
Bw1--- 6 to 16	23.1	48.0	28.9	7.3	7.3	5.3	4.0	5.0	8	19	grl
Bw2--- 16 to 22	19.7	47.4	32.9	8.1	7.8	6.2	4.3	6.5	16	31	grl
Bw3--- 22 to 29	16.5	47.0	36.5	9.0	9.6	7.5	5.2	5.2	10	33	grvl
Bw4--- 29 to 41	17.9	48.0	34.1	8.7	9.3	7.7	4.7	3.7	21	49	grvl
BC---- 41 to 70	15.3	41.7	43.0	9.6	12.4	9.9	6.3	4.8	20	62	flvl
Helechawa fine sandy loam: (85KY-095-6)											
A----- 0 to 5	7.3	21.7	71.0	10.7	21.9	34.1	4.1	0.2	5	6	sl
BA---- 5 to 10	8.5	23.1	68.4	11.1	22.8	33.8	0.6	0.1	7	9	sl
Bw1--- 10 to 20	11.3	23.4	65.3	10.8	21.7	31.6	0.7	0.5	5	7	sl
Bw2--- 20 to 38	13.6	22.8	63.6	9.8	19.5	33.1	1.0	0.2	4	6	sl
BC---- 38 to 49	15.0	17.1	67.9	7.6	15.0	43.6	1.4	0.3	2	5	sl
C----- 49 to 63	9.6	8.5	81.9	6.4	10.8	63.3	1.2	0.2	1	4	ls
Highsplint very channery silt loam: (85KY-095-4)											
BA---- 4 to 11	23.8	51.0	25.2	7.5	6.2	2.9	4.1	4.5	2	40	cnvsil
Bw1--- 11 to 28	28.0	51.1	20.9	6.1	4.9	2.8	3.5	3.6	TR	40	cnvsicl
Bw2--- 28 to 48	22.3	48.3	29.4	6.7	7.0	4.3	5.6	5.8	2	40	cnvl

See footnote at end of table.

TABLE 18.--PHYSICAL ANALYSIS OF SELECTED SOILS--Continued

Soil name, report number, horizon, and depth in inches	Total-- Clay (<0.002 mm)	Total-- Silt (0.05-0.002 mm)	Total-- Sand (2-0.05 mm)	Size class and particle diameter (mm) Very fine (0.1-0.05)	Fine (0.25-0.1)	Medium (0.5-0.25)	Coarse (1-0.5)	Very coarse (2-1)	Rock fragments 2-20 mm	Rock fragments >2 mm	Textural class*
	Pct <2 mm								Pct	Pct	
Jefferson gravelly silt loam: (85KY-095-1)											
A----- 0 to 3	10.9	53.5	35.6	11.8	18.2	3.5	0.7	1.4	9	20	grsil
E----- 3 to 9	12.6	55.4	32.0	10.8	16.9	3.3	0.4	0.6	7	20	grsil
BE---- 9 to 23	17.0	51.9	31.1	10.3	15.9	3.0	0.6	1.3	8	10	sil
Bt---- 23 to 31	17.5	47.0	35.5	10.6	18.1	3.8	0.8	2.2	14	25	grl
Bt---- 31 to 40	18.6	42.5	38.9	11.2	20.3	4.1	0.8	2.5	12	25	grl
BC---- 40 to 58	10.8	36.3	52.9	13.6	25.4	6.6	2.8	4.5	19	40	grvl
BC---- 58 to 75	15.1	38.4	46.5	13.1	19.9	5.1	2.1	6.3	20	40	grvl
Shelbiana loam: (85KY-013-1)											
Ap---- 0 to 9	15.0	47.6	37.4	20.2	13.1	1.6	1.2	0.7	---	TR	l
A----- 9 to 15	17.0	45.7	37.3	20.8	14.8	1.2	0.6	0.3	---	TR	l
Bt1--- 15 to 23	19.3	44.1	36.6	21.8	12.9	0.8	0.4	0.4	---	TR	l
Bt2--- 23 to 33	20.5	45.0	34.5	23.4	10.3	0.4	0.2	0.1	---	TR	l
Bt3--- 33 to 45	15.8	37.2	47.0	26.1	20.0	0.6	0.1	0.1	---	TR	l
BC---- 45 to 70	17.6	39.1	43.3	28.5	14.3	0.3	0.1	0.1	---	TR	l
Varilla gravelly fine sandy loam: (85KY-013-4)											
A----- 0 to 3	3.9	30.0	66.1	11.6	37.1	11.0	3.6	2.8	18	31	grfsl
Bw1--- 3 to 10	10.1	32.8	57.1	12.5	37.1	6.9	0.4	0.2	12	23	grfsl
Bw2--- 10 to 20	10.8	33.4	55.8	11.9	35.5	7.4	0.6	0.4	10	41	cbvfsl
Bw3--- 20 to 34	10.6	33.3	56.1	11.6	33.5	9.2	1.0	0.8	13	53	cbvfsl
Bw4--- 34 to 45	8.2	22.5	69.3	10.2	37.7	18.5	1.9	1.0	14	66	cbxfsl
BC---- 45 to 64	5.0	13.5	81.5	8.7	40.0	28.7	2.7	1.4	15	73	cbxls

* The letters ls mean loamy sand; cbxls, extremely cobbly loamy sand; sl, sandy loam; grfsl, gravelly fine sandy loam; cbvfsl, very cobbly fine sandy loam; cbxfsl, extremely cobbly fine sandy loam; l, loam; grl, gravelly loam; grvl, very gravelly loam; flvl, very flaggy loam; cnvl, very channery loam; sil, silt loam; grsil, gravelly silt loam; cnvsil, very channery silt loam; and cnvsicl, very channery silty clay loam.

TABLE 19.--CHEMICAL ANALYSIS OF SELECTED SOILS

(Dashes indicate that the element was not detected or that a determination was not made. TR indicates trace amounts. The pedons for the soils listed are typical of the series in the survey area. For the location of the pedons, see the section "Soil Series and Their Morphology")

Soil name, report number, horizon, and depth in inches	pH		Extractable cations					Extractable acidity	Aluminum	Cation-exchange capacity			Aluminum saturation	Base saturation		Organic carbon
	H_2O 1:1	$CaCl_2$ 2:1	Ca	Mg	Na	K	Total (TEC)			Sum of cations	Ammonium acetate	Effective cation-exchange capacity		Sum of cations	Ammonium acetate	
			Milliequivalents per 100 grams of soil										Pct	Pct	Pct	Pct
Cloverlick gravelly loam:																
(85KY-095-3)																
A-------- 0 to 6	4.9	4.7	9.9	1.7	TR	0.4	12.0	18.3	0.5	30.3	24.6	12.5	4	40	49	6.07
Bw1------ 6 to 16	4.8	4.2	1.7	0.5	TR	0.1	2.3	13.2	3.0	15.5	14.8	5.3	57	15	16	1.76
Bw2------ 16 to 22	5.0	4.3	1.9	0.8	TR	0.1	2.8	11.3	2.4	14.1	13.7	5.2	46	20	20	1.68
Bw3------ 22 to 29	4.9	4.2	0.7	0.6	TR	0.1	1.4	7.9	2.8	9.3	8.4	4.2	67	15	17	0.52
Bw4------ 29 to 41	4.8	4.2	0.6	0.7	TR	0.1	1.4	8.3	3.2	9.7	8.7	4.6	70	14	16	0.47
BC------- 41 to 70	4.7	4.1	0.3	0.4	TR	0.1	0.8	7.6	3.4	8.4	8.0	4.2	81	9	10	0.41
Helechawa sandy loam:																
(85KY-095-6)																
A-------- 0 to 5	4.2	3.8	0.3	0.2	TR	0.2	0.7	16.2	3.4	16.9	11.5	4.1	83	4	6	5.78
BA------- 5 to 10	4.5	4.3	---	---	TR	TR	TR	3.0	1.0	3.0	2.4	1.0	100	---	1	0.48
Bw1------ 10 to 20	4.5	4.2	---	---	TR	TR	TR	3.3	1.4	3.3	3.2	1.4	100	---	1	0.33
Bw2------ 20 to 38	4.4	4.1	---	---	TR	TR	TR	4.5	2.1	4.5	4.0	2.1	100	---	TR	0.27
BC------- 38 to 49	4.5	4.0	---	---	TR	TR	TR	5.5	2.8	5.5	4.6	2.8	100	---	TR	0.17
C-------- 49 to 63	4.4	4.0	---	---	TR	TR	TR	3.1	1.9	3.1	3.0	1.9	100	---	1	0.12
Highsplint very channery silt loam:																
(85KY-095-4)																
BA------- 4 to 11	5.2	4.5	1.8	1.0	TR	0.3	3.1	8.2	2.1	11.3	10.0	5.2	40	27	31	1.02
Bw1------ 11 to 28	5.0	4.3	0.9	1.3	TR	0.3	2.5	8.2	3.1	10.7	9.9	5.6	55	23	25	0.41
Bw2------ 28 to 48	5.0	4.2	0.7	1.6	TR	0.2	2.5	9.6	3.8	12.1	11.2	6.3	60	21	22	0.70
Jefferson gravelly silt loam:																
(85KY-095-1)																
A-------- 0 to 3	5.3	4.5	2.9	0.5	TR	0.2	3.6	9.0	1.0	12.6	9.3	4.6	22	29	39	2.67
E-------- 3 to 9	5.5	4.8	1.9	0.2	TR	0.1	2.2	5.1	0.5	7.3	5.5	2.7	19	30	40	1.17
BE------- 9 to 23	5.0	4.3	1.2	0.1	TR	0.1	1.4	5.3	2.3	6.7	5.4	3.7	62	21	26	0.27
Bt------- 23 to 31	4.9	4.2	0.7	0.6	TR	0.1	1.4	5.7	2.9	7.1	6.0	4.3	67	20	23	0.16
Bt------- 31 to 40	5.0	4.2	0.2	1.3	0.2	0.1	1.8	5.9	2.5	7.7	6.0	4.3	58	23	30	0.13
BC------- 40 to 58	5.1	4.3	0.1	0.8	TR	0.1	1.0	3.5	1.4	4.5	4.0	2.4	58	22	25	0.09
BC------- 58 to 75	5.3	4.4	0.2	1.2	TR	0.1	1.5	4.7	1.6	6.2	5.2	3.1	52	24	29	0.06

TABLE 19.--CHEMICAL ANALYSIS OF SELECTED SOILS--Continued

Soil name, report number, horizon, and depth in inches	pH		Extractable cations					Extractable acidity	Aluminum	Cation-exchange capacity			Aluminum saturation	Base saturation		Organic carbon
	H_2O 1:1	$CaCl_2$ 2:1	Ca	Mg	Na	K	Total (TEC)			Sum of cations	Ammonium acetate	Effective cation-exchange capacity		Sum of cations	Ammonium acetate	
			Milliequivalents per 100 grams of soil										Pct	Pct	Pct	Pct
Shelbiana loam:																
(85KY-013-1)																
Ap------- 0 to 9	5.4	---	4.6	1.3	0.1	0.2	6.2	7.4	---	13.6	11.3	---	---	46	55	2.9
A-------- 9 to 15	5.8	---	4.1	0.7	0.1	0.1	5.0	8.6	---	13.6	10.8	---	---	37	46	2.0
Bt1------ 15 to 23	5.4	---	2.5	0.4	0.1	0.1	3.1	12.3	---	15.4	9.4	---	---	20	33	1.3
Bt2------ 23 to 33	5.2	---	2.1	0.4	0.1	0.1	2.7	12.8	---	15.5	9.2	---	---	17	29	1.0
Bt3------ 33 to 45	5.1	---	0.7	0.2	0.1	0.1	1.1	7.7	---	8.8	5.8	---	---	12	19	0.6
BC------- 45 to 70	5.0	---	0.7	0.2	0.1	0.1	1.1	9.7	---	10.8	6.4	---	---	10	17	0.7
Varilla gravelly fine sandy loam:																
(85KY-013-4)																
A-------- 0 to 3	4.3	3.6	4.5	0.5	TR	0.4	5.4	20.7	2.4	26.1	22.3	7.8	31	21	24	9.45
Bw1------ 3 to 10	4.5	4.2	---	---	TR	0.1	0.1	5.9	1.7	6.0	4.3	1.8	94	2	2	0.75
Bw2------ 10 to 20	4.4	4.1	---	---	TR	TR	TR	3.9	1.6	3.9	3.7	1.6	100	---	1	0.29
Bw3------ 20 to 34	4.4	4.1	---	TR	TR	TR	TR	4.2	1.9	4.2	3.9	1.9	100	---	1	0.27
Bw4------ 34 to 45	4.6	4.0	---	0.1	TR	TR	0.1	3.0	1.6	3.1	3.2	1.7	94	3	3	0.17
BC------- 45 to 64	4.6	4.1	TR	0.1	TR	---	0.1	1.8	0.9	1.9	2.2	1.0	90	5	5	0.13

TABLE 20.--ENGINEERING INDEX TEST DATA

(Dashes indicate that data were not determined. NP means nonplastic. The pedons for the soils listed are typical of the series in the survey area. For the location of the pedons, see the section "Soil Series and Their Morphology")

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution											Liquid limit	Plasticity index	Moisture density		Specific gravity
			Percentage passing sieve--								Percentage smaller than--							
	AASHTO	Unified	>3 in.	1/2 in.	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Maximum dry density	Optimum moisture	
														Pct		Lb/cu ft	Pct	
Helechawa sandy loam:																		
(85KY-095-6)																		
Bw1--- 10 to 20	A-4(0)	SM	5	97	93	91	90	89	87	37	25	17	10	---	NP	122	12	2.69
Bw2--- 20 to 38	A-4(0)	SM	5	98	95	94	93	93	90	39	26	20	10	---	NP	121	12	2.68
Shelbiana loam:																		
(85KY-013-1)																		
A----- 9 to 15	A-4(4)	ML	0	100	100	100	100	100	100	72	48	27	13	33	6	99	19	2.66
Bt2--- 23 to 33	A-4(5)	ML	0	100	100	100	100	100	100	82	48	30	18	31	6	105	19	2.68

TABLE 21.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Allegheny	Fine-loamy, mixed, mesic Typic Hapludults
Alticrest	Coarse-loamy, siliceous, mesic Typic Dystrochrepts
Bethesda	Loamy-skeletal, mixed, acid, mesic Typic Udorthents
Bonnie	Fine-silty, mixed, acid, mesic Typic Fluvaquents
Cloverlick	Loamy-skeletal, mixed, mesic Umbric Dystrochrepts
Craigsville	Loamy-skeletal, mixed, mesic Fluventic Dystrochrepts
Crossville	Fine-loamy, siliceous, mesic Umbric Dystrochrepts
Cutshin	Fine-loamy, mixed, mesic Typic Haplumbrepts
Fairpoint	Loamy-skeletal, mixed, nonacid, mesic Typic Udorthents
Gilpin	Fine-loamy, mixed, mesic Typic Hapludults
Guyandotte	Loamy-skeletal, mixed, mesic Typic Haplumbrepts
Helechawa	Coarse-loamy, siliceous, mesic Typic Dystrochrepts
Highsplint	Loamy-skeletal, mixed, mesic Typic Dystrochrepts
Jefferson	Fine-loamy, siliceous, mesic Typic Hapludults
Kimper	Fine-loamy, mixed, mesic Umbric Dystrochrepts
Philo	Coarse-loamy, mixed, mesic Fluvaquentic Dystrochrepts
Pope	Coarse-loamy, mixed, mesic Fluventic Dystrochrepts
Renox	Fine-loamy, mixed, mesic Ultic Hapludalfs
Sequoia	Clayey, mixed, mesic Typic Hapludults
Sharondale	Loamy-skeletal, mixed, mesic Typic Hapludolls
Shelbiana	Fine-silty, mixed, mesic Typic Palehumults
Shelocta	Fine-loamy, mixed, mesic Typic Hapludults
Totz	Mesic, coated Lithic Quartzipsamments
Varilla	Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

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